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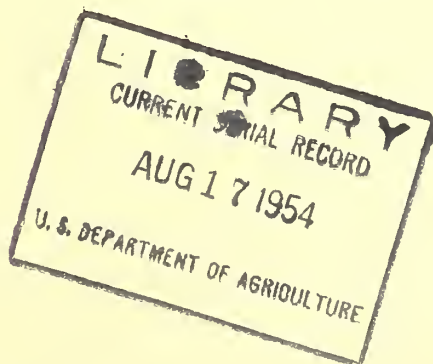
1954

Report of the Joint Session of the Eleventh
SOUTHERN PASTURE AND FORAGE CROPS IMPROVEMENT CONFERENCE
and the

WESTERN GRASS BREEDERS WORK PLANNING CONFERENCE

Oklahoma A. & M. Campus, Stillwater, Oklahoma

June 8-11, 1954



Report of the Joint Session of the Eleventh
Southern Pasture and Forage Crops Improvement Conference
and the
Western Grass Breeders Work Planning Conference
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Tuesday, June 8

9:00 A.M.	Opening Session	Auditorium Classroom Bldg.	<u>Page No.</u>
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^{1/} Reported by J. K. Patterson, Secretary, Western Grass Breeders Work Planning Conference and Paul R. Henson, Permanent Secretary, Southern Pasture and Forage Crops Improvement Conference, and assisted by Jack R. Harlan, Roger Peterson, Alvin G. Law and others.

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8:30 AM SOUTHERN PASTURE AND FORAGE CROPS IMPROVEMENT CONFERENCE

J. K. Leasure, Chairman Auditorium, Classroom Bldg.

<u>Report on the Southern Regional Project S-12 -</u>	
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1:15 PM OPTIONAL TOUR BEGINS

Assemble at El Reno Livestock Research Station. Tour forage crop seed production studies and livestock and pasture work. On to Woodward that evening.

Friday, June 11

8:00 AM Assemble at office of Field Station on South 18th St. (1 mi. south of Main St.) Tour breeding plots and on to range unit northwest of Ft. Supply.

Final adjournment at Ft. Supply

Registration List	50
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June 8. 9:00 A.M. - The joint conference was called to order by Dr. J. K. Leasure, Tenn. Agric. Expt. Station, Chairman of the Southern Pasture and Forage Crops Improvement Conference and by Dr. J. R. Harlan, Okla. Agric. Expt. Station and USDA, Chairman of the Western Grass Breeders Work Planning Conference. Dr. Harlan introduced the speakers.

The members of the two conference groups were welcomed to Oklahoma A & M by President of the Institution, Dr. Oliver S. Willham, and by Director of the Agric. Expt. Station, Dr. Lewis E. Hawkins.

Members were introduced by states. One or more members were present from the States of Va., Md., N. Car., S. Car., Ky., Tenn., Ga., Fla., Ala., Miss., La., Ark., Mo., Tex., Okla., N. Mex., Kans., Colo., Utah, Iowa, Nebr., N. Dak., S. Dak., Mont., Wyo., Wash., and Oreg. A total of 27 states were represented.

Grass Breeding, with Special Emphasis on Evaluation - /Glenn W. Burton/
Ga. Agric. Expt. Station and USDA, Tifton, Ga.

I should like to begin this talk by asking ten questions that we think should be asked of any new grass or legume.

1. When does it grow?
2. Where will it grow?
3. How efficient is it, particularly in nutrient and water use?
4. How much will it produce?
5. How palatable and nutritious is it?
6. Is it good for pasture, hay and/or silage?
7. How hard is it to establish and manage?
8. How dependable is it?
9. Does it have ceiling properties?
10. Can it become a pest?

If the forage breeder had the answers to these questions concerning the many species that show promise he could choose the best, concentrate his efforts on one or two and make much more progress than he is now able to make. If his new variety is greatly different from the species, it will be highly desirable, in my opinion, to invest some time and money answering these questions about it.

Once the breeder has chosen the species he becomes interested in making local and world collections of ecotypes - building blocks for his breeding program. He may even wish to include collections of closely related species with the thought of using interspecific hybrids should such a program seem desirable.

He also must understand the method of reproduction of his material. Does it reproduce sexually or by apomixis? Is apomixis so complete that hybrids cannot be made? Does the hybrid fail to segregate because of apomixis? Hybridization techniques must be worked out. Cytogenetic information can greatly facilitate the work and should be obtained if possible.

Early in the program the breeder must decide how the end product of his effort is to be propagated. If the grass is stoloniferous, vegetative propagation is possible and offers some definite advantages. In the South today, there are at least one-half million acres each of Pangola grass and Coastal Bermuda. Both are propagated vegetatively and many farmers using the best planting methods say it costs less to plant these grasses than to establish many others from seed.

If the new variety is good enough, vegetative propagation of bunch grasses can be economically feasible.

Leafiness can often be increased by widening the leaves and shortening the internodes, a procedure followed in breeding Starr millet. Extending the maturity date caused it to furnish grazing a month longer than common millet.

If many of the clones are highly self-sterile, the procedure we have followed in breeding Pensacola Bahia may be used. Ninety some superior clones were selected from several thousand spaced plants and were tested for general combining ability in a polycross test. Tests for specific combining ability of some of the best clones gave two clones which, when interplanted vegetatively, give a hybrid yielding 10 to 25% more in clipping trials. The vegetatively propagated seed field, properly managed, can produce hybrid seed for many years by a straight combining process.

The procedure that we have suggested for producing high yielding chance hybrids of cattail millet should be suitable for other highly cross-pollinated species if the chance hybrid seed can be planted thickly enough(perhaps in rather wide rows or hills), so that the more vigorous hybrid seedlings can crowd out the inbreds in the seedling stage.

The near-seedless Oregon Ladino has persisted longer and yielded considerably more than the seed-producing southern white. "Seedless" types of most forage plants might also be superior to "seed-producing" types in quality and ease of management. The near seedless character of Oregon Ladino at Tifton is a day length response. A superior clone of tall fescue that has been near seedless at Tifton, Ga., is flowering freely in Oregon. Perhaps this phenomenon can be used with many species to facilitate the propagation by seed of superior "seedless" types. Certainly it might well be explored before the good "seedless" types are discarded.

The screening process usually begins with the space planting of segregating populations under uniform environmental conditions. Large populations are a must in most instances. The well trained eye can successfully select for disease resistance if a uniform epiphytotic can be created. Maturity, type, persistence frost resistance, etc., can also be evaluated by the eye. Progeny tests are essential to reveal the heritability of the character in question. The best potential of a new selection should be considered before large investments in evaluation are made. Quite early in the testing program I should like to see the productivity of the material critically measured. Well designed clipping trials to measure relative production under at least two clipping treatments(simulating different grazing systems) should be used. Efficiency in fertilizer and water use and ceiling properties warrant investigation. Such quality measures as palatability and nutrient content should also be measured. Compatibility with other pasture plants and ease of establishment and management should be studied. Final evaluation of the material by the class of animals destined to become its ultimate consumer will be highly desirable, particularly if the new variety differs greatly from other members of the species already so evaluated.

Finally, the new variety must find a place on the farm. The animal and his master will pass final judgment on it. If we have done a thorough job of evaluating our material and release only varieties of proven superiority this phase of the program is reasonably sure to succeed. If, on the other hand, we release many varieties before they are adequately tested and our farmers find them no better or inferior to material they now have we may one day find ourselves sharing a bed with the boy who cried "wolf, wolf". Our forage breeding program will be no better than our testing program.

A major factor in the development of a new crop for livestock use or an improved management practice for an existing crop is to improve the quality of the forage. This immediately raises the problem of quality evaluation. This evaluation must be performed (a) during the developmental process of producing new strains, (b) while testing introduced varieties not indigenous to the area, (c) in developing management schemes which make maximum use of the soil and water resources of the area. This quality evaluation should be performed at the location of the production of the forage, but if this is impractical, then at distances which preclude major changes in quality due to transport and storage. In measuring quality it is necessary to consider the following: (a) type of animals which will use it; (b) physiological need of animals, for example, growth, fattening, reproduction and lactation, or milk production; and (c) system of management, which will frequently be a tremendous factor in modifying quality.

Once the conditions have been established, the methods must then be selected. Four primary means are currently available - (a) biological performance, (b) combined chemical-biological procedures, such as digestion trials, (c) determination of chemical constituents, and (d) various physical measurements (leaf stem ratio, breaking strength of blades or stems, etc.).

The biological test must continue to be the basis for comparison of all others. For many purposes, however, it is precluded because of the lack of availability of material for testing. Other "screening tests" must, therefore, be developed, although ultimately full biological testing of the most promising strains or practices will be required.

The combined biological-chemical evaluation - the traditional digestion-metabolism trial - rests on certain assumptions, namely: (a) physiological performance of animals is not affected by the conditions of the test, (b) grazing habits are not affected by the conditions of test if the test is performed on the pasture, and (c) high correlation exists between the apparent digestibility of the ration components as revealed by digestion trials and the utilization of these components by the animal under the practical conditions to which these data are extrapolated. Two principal techniques are employed for digestion trials of pastures and fresh forages, namely: harvesting of forage and feeding to steers and wethers in traditional digestion trials and indicator methods.

The desirable features of the conventional harvesting method are: (a) techniques are thoroughly worked out and limitations and precision understood, (b) technique permits of standardization of experimental subjects by using standard reference forage for comparison purposes, and (c) it permits accurate assessment of intake of feed - not usually possible by other methods. Its undesirable features are (a) excessive labor cost in collection of forage at frequent intervals, (b) necessity for frequent analysis of forages, since this will be constantly changing, and (c) failure to determine what the animal actually consumes, since even if the plants are plucked to simulate grazing (a most time-consuming and tedious business), this is recognized to be only a first approximation, and (d) the abnormal condition of the animal - restraint, restricted ration with effect on palatability, etc.

Indicator methods have been widely discussed. The principle of the method is simple - some constituent is selected which passes through the G.I. tract unchanged and the quantity determined in feed and feces. Knowing the composition of the ingesta and excreta, the percentage digestion of any component can be readily calculated. Quantitative collection of feces need not be made if distribution of indicator is uniform in fecal material. The indicator method is also applicable to calculating the dry matter or organic matter intake of animals on pasture if quantitative fecal collections are made. The desirable features of this method are as follows: (a) permits maintenance of animals under far more normal conditions, (b) makes quantitative feeding of forage unnecessary - hence great savings in labor costs, (c) makes quantitative fecal collection unnecessary if indicator is uniformly distributed - and if feed intake is not required or can be estimated by other means. The undesirable features are (a) makes an additional analysis on feed and feces necessary - in case of certain constituents, the methods may be rather laborious, (b) variation in the rate of excretion of the indicator with time may interfere seriously with use of "grab" samples, (c) assumes that the indicator undergoes no change and is measured to an equal degree in samples of feed and forage, (d) problem of determining what the animal is actually consuming is still present. There is a possibility of circumventing this difficulty if constant relation exists between forage indicator content and fecal indicator content. The proposal of Reid with chromogen technique would permit determination of digestibility of the dry matter without collection of forage samples.

Quality evaluation by chemical methods is the third method available to the plant breeder and the grassland agronomist. Here again certain and basic assumptions are made and these should be understood if the limitation of the data are to be recognized. The two main ones are: (a) high correlation exists between the chemical composition of the plant and its utilization by the animal, (b) the sample of material analyzed represents what the animal would be grazing or there is a very high correlation between the response of the animal grazing the pasture and consuming the forage of which the sample is a representative part.

The traditional feed analysis procedure has been used practically unchanged since its development nearly a century ago by Henneberg and Stohmann at the Weende station. An obvious defect of this method from the standpoint of the chemist is its complete failure to provide any reasonably precise fractionation of the carbohydrate components into more or less definite fractions with respect to their digestibility by ruminants. A tremendous amount of effort has gone into the attempt to devise improved methods, with the result that to date Weende crude fiber still remains as good as any other single simple component for evaluating animal feedstuffs of widely differing composition, particularly for non-ruminants.

It is generally considered that the "crude fiber" fraction represents a fraction of the plant or feed with a high correlation to the digestibility of the feed. Evidence for this is presented by Lancaster, who examined the relationship between crude fiber and organic matter digestibility of 17 New Zealand forages, varying from turnips and kale through hays to oat chaff (crude fiber range = 10.7 - 34.1). On calculating the regression of digestibility of the organic matter on the crude fiber content, a remarkably high correlation was

obtained, R being = -0.944 . Contradictory evidence is presented by Common, however, with 18 samples of Irish grass and hay. Here it is found that there was no useful correlation between digestibility and crude fiber, R being = $+ .336$ with 16 D.F. The samples from the north of Ireland were much more nearly alike than would be encountered in studies on pastures. Further evidence is forthcoming from studies like those of Savage and Heller on the native grass ranges of the Southern Great Plains.

Lancaster found a remarkably high value of $R = - 0.978$ for digestibility of the forages studied on lignin content. Common also found a useful, though lesser correlation, ($R = - 0.419$ for 16 D.F., significant at $p = 0.10$) for his Irish hay samples. Similar findings are made by the French workers, Francois and Leroy. They suggest that the correlation between digestibility of the organic matter to Lignin is an even better index than lignin alone and find with sheep correlation coefficients of $R = - 0.89$ for a variety of forages (again at widely varying crude fiber and lignin content).

In the case of forages, there appears to be a high correlation between protein content and digestibility. Thus, for Oklahoma prairie hays, Briggs and Gallup found a correlation of $R = 0.830$ for prairie hay of protein content varying from 3.0 to 5.9 percent. This is confirmed by many other workers. That there is a relatively high correlation between protein and forage quality can be seen from the data of Savage and Heller.

On the basis of present knowledge, it would be unwise to state which of the numerous factors is the best index of quality. From my study, it would appear that for feeds of varying composition a combination of protein and lignin would provide maximum information with minimum effort.

that
It is hoped that the emphasis/has been placed upon the role of the chemist in this job of evaluation is not misunderstood to suggest that he is more than a member of the three-way partnership that is necessary for us to reach our goal of more efficient pastures for tomorrows livestock. As a joint committee of the American Society of Agronomy, the American Dairy Science Association, the American Society for Animal Production, and the American Society for Range Management pointed out in their report:

"Pasture research investigations involve knowledge of plant and animal, nutrition, parasites, and disease of plants and animals, soils, climatic factors, statistical methods, plant physiology and other factors. Because of the complex nature of these factors and their inter-relationship, specialists in various fields of scientific training would work as a team. If this recommendation is followed, the end result will be more valid, comprehensive and acceptable data".

Tuesday, June 8.

1:30 P.M. Section I, Plant Breeding, First Session - J. R. Harlan, Chairman
Breeding Orchardgrass for Yield in Pasture Mixtures - Wesley Keller,
Pasture & Range Section, ARS, USDA, Logan, Utah.

An experimental planting made in the spring of 1945 followed an early used

competitive design (Agron. Jour. 38: page 584. 1945). Of nearly 10,000 plants set out one foot apart, approximately 1400 were orchardgrass. On the basis of both yields and appearance 50 were selected in the spring of 1947. Of these, 14 were relatively late flowering. They were cloned and crossed in all combinations (6th. Grassland Congress Proc., Emasculation and Pollination Techniques - Keller) and progenies tested by transplanting into 18-inch squares made by drilling solid rows of orchardgrass alternating with tall oatgrass in one direction, and red clover alternating with alfalfa at right angles. Five harvests (2 in 1952 and 3 in 1953) indicate wide differences in individual progenies and that if 4 parent plants are chosen for a new strain, general combining ability is a very reliable procedure, while if only 2 parents are chosen, specific combining ability appears much better. In one harvest (2nd of 1953) percent total nitrogen, phosphorus, and calcium were positively related (values generally low) to one another, but all negatively related to yield. The range of variation among the 4 characters led to significant differences but yield varied so much more than chemical composition that the data suggest selection for yield alone will generally increase the acre-yield of the chemical constituents also. Selection for percent nitrogen or phosphorus may be effective in raising the acre yield of these nutrients. Calcium was rather strongly related (negatively) to yield to the extent that selection for high percent calcium would lead to low per acre yields of it (as well as of herbage).

DISCUSSION:

Bennett: What temperature was used for emasculation?

Keller: 46° C for 3 minutes - slightly higher in the middle of the day.

Question: How close to anthesis?

Keller: About 2 days.

Keller also described a study on relative efficiency of water use by different clones. Clones were grown in gallon cans topped with pea gravel. Water differential supplied by bringing cans to field capacity at various intervals. Efficiency of water use measured by yield. Some 30-35% of the water lost evaporated through ^{the} pea gravel. This was reduced to only 3% by topping with Kraft paper. There were significant differences between clones in efficiency of water use.

The Role of Heritability Studies in Orchardgrass Breeding - A. A. Hanson, Forage and Range Section, ARS, Beltsville, Md.

The cytogenetic behavior of orchardgrass was reviewed. Present data suggests that economic characters in orchardgrass may exhibit either disomic or tetrasomic inheritance, and it is not unreasonable to assume that both modes of inheritance may be involved in the expression of some polygenic characters. An understanding of parent-progeny relationships is essential to intelligent selection. In general, the degree of relationship has been expressed as correlation coefficients.

Schultz obtained a significant correlation coefficient ($r = 0.45^*$) for winter hardiness of parental clones and selected I_1 clones. In the same experiments r values of 0.32 and 0.72^{**} were obtained for self-fertility and rust reaction, respectively. Myers has reported highly significant parent-inbred progeny correlations for number of seeds per panicle set under bag ($r = 0.62^{**}$) and open-pollinated seed set ($r = 0.49^{**}$). Myers and Chilton found a high parent-inbred progeny association for degree of winter injury ($r = 0.91^{**}$). Weiss et al studied the relationship of parental clones and their open-pollinated progenies grown in short replicated single row plots. They found essentially no association for yield and leafiness, but significant correlation coefficients were obtained for leaf width ($r = 0.47^{**}$), panicle number ($r = 0.51^{**}$) and winter survival ($r = 0.33^*$). Correlation coefficients between a number of single crosses and the mean performance of their two parental clones were highly significant for leafiness ($r = 0.46^{**}$), leaf width ($r = 0.44^{**}$), panicle number ($r = 0.41^{**}$), winter survival ($r = 0.79^{**}$), leaf diseases ($r = 0.43^{**}$) and lodging ($r = 0.58^{**}$). There was essentially no association between the yield of the parental clones and their single cross progenies. Kalton et al calculated parent-inbred correlations in a replicated nursery in which each plot contained 13 S_1 and 3 S_0 plants in a single row. In this planting the parent-inbred progeny correlation for mean first-cutting yield, second-cutting yield, spring vigor score, panicle number, height, leafiness score and winter injury were all highly significant, ranging from 0.52 to 0.79. Other comparisons based on single parental plants and their non-replicated inbred progenies were inconsistent and low.

Most breeding work is based to some extent on the assumption that the genes governing quantitative characters are arithmetic or additive in their action. This assumption has been used as a basis for estimating heritability percentages in an effort to obtain some approximation of the progress that might be expected in practicing selection within segregating populations. Heritability as used in the studies has been defined in the broad sense as the proportion of the total variance due to genetic effects. Kalton et al found that heritability percentages for panicle number and forage yield were low while the percentages obtained for height, leafiness and spring vigor were reasonably high, ranging from 35 to 56 percent. The various factors involved in the interpretation of this type of data were outlined. Burton and DeVane obtained high heritability values for all of the tall fescue characters that they investigated. Their results suggest that heritability values for yield may be of the same magnitude as those for other characters if the error mean square is reduced by replication. Unpublished data on the heritability of maturity in orchardgrass and comparisons among different types of progenies in estimating parent-progeny relationships were reviewed.

The predictive value of observations taken on individual plants is generally poor for yield, vigor, recovery and height, and fair to good for disease, winter hardiness, leaf width, self and cross fertility and maturity. The predictive value of observations on characters associated with forage yield may be improved by replication.

DISCUSSION:

- Ross: Is it not true that an heriditability estimate applies only to a given stage in the breeding program and that the heriditability of a character tends to become lower as the breeding program progresses?
- Hanson: Yes. The differences in heriditability of some characters might be used to indicate progress in the program.
- Harlan: In measuring parent-progeny correлтаions does it matter if the populations are established in spaced arrangements, rows, or plots?
- Hanson: Method of planting is important. Under certain conditions any one of several methods may be satisfactory. Provision should be made for adequate replication.
- Fergus: What are the possibilities of developing superior varieties and maintaining them under present certification procedures?
- Hanson: In general, the present procedures are adequate to maintain the superiority of a variety.
- Fergus: Can superiority be maintained without regard to the number of generations?
- Hanson: The problem in orchardgrass should not be as great as in some of our leguminous crops because of the partial autopolyploidy exhibited by this species. Synthetics should be rather stable for most characters.
- Law: How many seed generations should a synthetic be advanced?
- Kalton: We are just now getting data on orchardgrass. In brome grass there is no great drop in performance.
- Harlan: Is orchardgrass more autoploid than alfalfa?
- Hanson: They are probably similar, but cytologically orchardgrass exhibits more antoploid tendencies having more quadrivalents, etc.
- Graumann: We are now studying four generations of 2-clone synthetics vs. 4-5 clone synthetics. In general, the 2-clone combinations yield more in Syn 1 but drop faster in yield, so that by Syn 4 both types of synthetic are about the same and all are only slightly higher than the average of the check varieties.

Stem rust is very damaging to orchardgrass in all sections of Virginia. We have obtained satisfactory inoculation on seedlings and subsequent readings in the greenhouse by using methods patterned after those worked out by cereal breeders.

Mildew, if it once gets started in the greenhouse, is difficult to control and will seriously interfere with rust inoculations and subsequent readings. All of our breeding material has been selected for a high degree of rust resistance. All clones are being selfed and S_1 progeny are tested for rust resistance in order to give a measure of relative homozygosity of parent clones for rust resistance. No identification of races of rust have been attempted.

It was pointed out that the selection of individual plants in a breeding program is still dependent upon visual characteristics prior to using concrete scientific bases and measurements. Additional information on characteristics of seedlings as well as mature plants and correlations with later performance would give the breeder a better chance of selecting a clone at this early stage that might ultimately meet desired standards.

Variations in seed production and leafiness of different orchardgrass clones under two levels of nitrogen was shown by slides. Some clones gave the same relative performance under two levels of nitrogen while others showed big differences in performance and especially in seed production. Most of the Virginia material will probably be tested for seed production under different fertility levels, especially nitrogen, at some stage in the program.

Our program is aimed primarily at developing more persistent varieties, both for hay and pasture, and also when grown in combination with different legumes. Both early and late varieties will be needed along with a high degree of resistance to diseases, especially stem rust and possibly Scolecotrichum and Stagonospora.

A study on correlation of phenotypes of certain orchardgrass clones with persistence under different management and legume associations is being started. If it seems justified, this work may be continued further with grazing.

DISCUSSION:

Kalton: What is the rust?

Smith: Stem rust - we have no leaf rust problems at present in Virginia.

Kalton: What species?

Smith: Puccinia graminis, but we have not been able to infest orchard with rusts from cereals or vice versa.

Kalton: How do you inoculate?

Smith: Collect the uredospores in the fall before frost, store in freezer. Material can be built up in greenhouse. Put pots in tub and sprinkle with spores or better, rub individual plants with spores and talc. Cover for 24-48 hours and incubate for 2 weeks before reading. Rust is ready for collection in about 3 weeks.

Kreitlow: Are there different pustule types?

Smith: Yes.

Question: Is rust the main problem in Virginia?

Smith: Yes, but Scolototrichum and Stagonospora can be very bad.

Pickett: Do you have resistance to Scolototrichum?

Smith: Very little.

Tall Fescue Breeding

Some Breeding Behavior Studies with Tall Fescue - J. R. Cowan,
Oregon Agric. Expt. Station, Corvallis, Oreg.

This tall fescue program was initiated in 1949. The first main objective was to establish the variability, if any, and range in variability of various important breeding characteristics. Characters such as yield of seed and forage, self-fertility, recovery after cutting, nutritional value, seasonal adaptation, etc., were made. Along with these a number of technique and methodology studies such as cloning, number of panicles per isolation bag, number of samples per plant, relation of seed and forage yield in the same plant were carried out.

Range in yield of seed and forage was very wide. Ability to recover after intensive and frequent cutting is very marked. There has been a definite indication of differences between seasonal response of different genetic sources. There is a wide range in growth habit; that is leaf width, harshness versus smooth texture, upright versus decumbent growth and degree of aggressiveness.

An attempt is being made to ascertain whether measurable nutritional differences exist between genotypes. Preliminary studies have been commenced examining rather critically some 20 genotypes. These have been placed in two separate experiments. One has been clipped frequently to simulate pasture stage of usage (12 cuts per year). The other has been treated as a stage of maturity study. Five stages from pasture up to and including seed in soft dough plus eight aftermaths at monthly intervals. Harvests on both studies have been carried out through the entire year. Samples for biochemical analysis have been taken on each harvest from every replication. So far only protein percent determinations have been made. There is a definite indication that there is variation in protein per genotype due to seasonal effects. However, all genotypes do not behave the same. Within any one harvest there has been a range in protein percent up to 10. Later the extremes in this study will be increased vegetatively to provide enough forage for feeding trials. In 1954 an attempt will be made to determine the potential range in digestibility by use of the chromogen method.

Dr. Hanson commented on the interesting results obtained from interspecific hybridization with Festuca and Lolium. He also reviewed the tall fescue breeding program at Kentucky. Selections were screened for palatability and superior plants increased by selfed and by open-pollinated seed. Inbred lines from testing programs have been included in an isolated polycross nursery. The program looks very promising.

Acceptability of tall fescue may not be a major problem under some conditions. On the other hand, information is needed on the significance of palatability in defining screening objectives. The program at Kentucky should provide some basic information on the value of this approach in tall fescue and help to shed some light on related problems in other grass species.

DISCUSSION:

Burton: The principal problem with fescue on the Georgia Coastal Plain is persistence. It tends to go out.

Pickett: Why?

Burton: Summer competition.

Fergus: We are much concerned over the question of palatability and are trying to improve it, but I wonder if palatability is the real problem. Is a palatable plant more nutritious?

McCullough: Palatability is not the problem in Georgia. Intake is better than for Starr millet and digestibility is about the same. There is some other factor that is missing and which has the effect of stimulating production or there are some factors present that inhibit production. We have not yet put our finger on the problem. Neither palatability as measured by intake nor digestibility as such, are the causes of poor production on fescue forage.

Fergus: Livestock variation is also involved. Some individuals do well on fescue. There may well be lactogenic factors that do not show up in chemical analyses.

Harlan: What do we know about the net energy value of fescue forage?

McCullough: Nothing. It has not been measured, but here again the net energy must depend upon some factor or factors that stimulate cell metabolism.

Sell: Net energy may be quite important. Steers and sheep supplemented with some high energy feeds produce as well on fescue as on the best pastures.

Hawk: What about fescue foot?

Sell: Authentic cases are uncommon but rather widespread.

Cowan: There is some indication that it may be associated with high selenium uptake in California. Probably not very serious.

Keller: The trouble appears always to be associated with soil problem areas.

+ Possibilities for the Improvement of *Phalaris* spp. - R. C. Pickett,
Kans. Agric. Expt. Station, Manhattan, Kans.

Phalaris arundinacea has a great potential, good yield, tolerance to a very wide range of moisture conditions and very little disease to date. We need non-shattering types with better seedling vigor. Seedlings are especially sensitive to drouth and frost. Palatability is rather low. *P. tuberosa* has good quality and drouth resistance but lacks winter hardiness. Hybrids between the two show considerable promise. In general, we need more material from as widely separated sources as possible. A thorough domestic exploration would be desirable as well as foreign introductions.

DISCUSSION:

Pickett: What other species might we use? *P. minor*? *P. paradoxa*?

James: There is little interest in *P. paradoxa*, *P. minor* and *P. canariensis*.

Hawk: *Phalaris* has great possibilities for erosion control.

Kalton: We plan an extensive collection in Iowa and Minnesota this fall.

Pickett: Good. We have found northern sources of reed canarygrass to be relatively good in the south as compared to other species moved southward.

June 8, 1:15 P.M. Section II. Pasture Management, Session I.
D. S. Chamblee, N. Car. Agric. Expt. Station,
Raleigh, N. Car., Chairman

The Place of Perennial Sods of Pure Grass in the South

+ The Value of Pure Grass vs. Grass-Legume Sods - E. H. DeVane
Ga. Agric. Expt. Station and USDA, Tifton, Ga.

Legumes have generally been considered to be more desirable pasture plants than grasses from a forage value standpoint. However, due to their number, hardiness, high yield potential, adaptability and usually good palatability under moderate fertility, grasses form the base of most all our pastures. One of the first and most lasting effects of sods is their influence upon the soil where they grow. Although the extensive root system of sods may add some to the fertility of the soils (especially nitrogen in legumes) by way of organic matter, perhaps the chief beneficial effects are the improvement in the physical properties such as permeability, aeration and aid to aggregations and soil structure; while the aboveground parts of complete sods act as a buffer to fluctuating air temperatures.

Karraker, reporting on work done in Kentucky on a Maury silt loam soil from 1921-1940, showed an average increase of 296 pounds per acre of soil nitrogen when red clover was the hay crop in a 3-year rotation experiment using corn-wheat-clover. He showed a decrease of 323 pounds of nitrogen per acre when soybeans was the hay crop. When orchardgrass was the hay crop, there was a loss in soil nitrogen of 22 pounds per acre. On the same soil, samples were taken from an area which had been in continuous cultivation since 1903 in tobacco in summer and a small grain cover crop in winter and a bluegrass-white clover roadway adjacent. The results were as follows: On the cultivated area at the 0-7" depth, 2460 pounds of N per acre were found in comparison with 4360 pounds on the bluegrass-white clover roadway. At the 7-18" depth in the cultivated area, 3320 pounds of N per acre were found in comparison with 5880 pounds of N per acre for the bluegrass-white clover roadway.

At Tifton, Georgia, on a Tifton sandy loam, the average percent organic matter under 7-year-old sods of Bermuda and Paraguay Bahia was found to be .74% and .81%, respectively, at the 0-6" depth, while adjoining cultivated fields (20 years) averaged .66% organic matter. Percent N at this depth was .041 under Bermuda, .41 under Bahia, and .035 under continuous cultivation. When crimson clover was grown with Bermuda, there was an average percent N increase from .040 to .047% and a total per acre hay production increase from 32,966 pounds with grass alone to 36,969 pounds with the mixture. In other work at Tifton, Georgia, on a deep sand, a measure of root development on 2-year-old sods to a depth of eight feet resulted in the following dry-root yields in pounds per acre: Common Bermuda, 6326; Coastal Bermuda, 5278; Suwannee Bermuda, 5102; Pangola, 3652; Pensacola Bahia, 9250; and carpet grass, 4160. Although these yields do show extent of root development, there were striking differences in the efficiency of the root systems as shown in fertilizer uptake, drouth resistance and forage yield.

Perhaps the most important single interest and objective for this group in this report is the potential productivity of grass sods versus grass-legume sods, and that of production measured in terms of per acre yields of forage, meat, milk, protein and carrying capacity or grazing days. In a beef production study on Coastal Bermuda at Tifton, Georgia, the average 4-year yields (1950-1953) in terms of beef per acre were as follows: With 50, 100 and 200 lbs. of N per acre, the corresponding beef yields were 292, 453 and 695 from April 1 - October 1. Two years' data in this test, using Crimson clover as the nitrogen source, resulted in 363 lbs. of beef per acre, and one year's results, using Blue lupine, gave 320 lbs. of beef per acre or the calculated approximation of 75 lbs. N from commercial fertilizer.

The 1952 average seasonal dry matter production in pounds per acre of the legume-grass associations on Coastal Bermuda sods and Bermuda alone established in November 1949 on Orangeburg soil at Tifton, Georgia, were as follows: Ladino, 8097; La. White, 7392; Dixie Crimson, 6913; Subterranean, 6750; Annual sweet, 9119; Hairy lotus, 5971; Smooth lotus, 6185 and Coastal Bermuda alone, 6792. The protein production in pounds per acre when using 1800 lbs. of an 0-8-8 fertilizer, were as follows: Ladino, 1076; La. white, 1115; Dixie Crimson, 887; Subterranean, 818; Annual sweet, 963; Hairy lotus, 780; Smooth lotus, 692 and Coastal Bermuda alone, 658. The extended growth of Ladino and La. White clover resulted in higher total forage and protein production on this high-water-table soil. The Ladino and La. White clover had a moderate

stand, even in summer. The N removal per acre ranged from 105 lbs. per acre with the Coastal Bermuda alone and 178 lbs. per acre with the La. White clover-Bermuda association. This shows that all the legumes in this case furnished more N than the 100 lbs. supplied in commercial fertilizer, as well as increased the nutritive value of the forage as shown by protein yield. The average protein percentage with 1800 lbs. of 0-8-8 ranged from 10.12% with Bermuda alone to an average of 14.09% with the La. White clover association.

It goes without saying that pure grass sods must be furnished with sufficient fertilizer, and especially N, to obtain the production and quality of forage desired. At Tifton, the seasonal production has ranged from approximately one ton/A without fertilizer to 8 tons/A with 400 lbs. of N, and as much as 14 tons of hay/A with 600 lbs. N supplied in a 2-1-1 fertilizer ratio. Adequate N applications when spaced, will maintain production and quality on our better grasses - One pound N will usually produce two pounds of beef on Coastal Bermuda. Pure grass sods with N use seem to be most practical in cases where legume growth has been usually poor due to unfavorable soil conditions (nematodes, dry sandy soils), when legumes have died out, and when high production during certain periods is desired. Where environment makes it possible to maintain a legume-grass mixture it is certainly to be desired from the standpoint of additional benefit to the physical properties of the soil, a cheaper and more evenly distributed source of N, usually a more even and higher seasonal quality of forage (of most benefit, it seems, to dairy animals), and increased forage production in comparison to pure grass sods when using only light rates of nitrogen fertilizer.

DISCUSSION:

Potts: Is grass generally considered to be less palatable than legumes?

DeVane: It developed that while legumes are usually considered to be more palatable, the generalization would not be true in all areas.

Potts: Can you produce as much from a grass-legume sod as from a pure grass sod?

Killinger: There were no real data available where yields might approach those reported on highly fertilized Coastal Bermuda. No data are available where both the grass and legume in the mixture received proper fertilization for maximum production of both species. The possibility of securing greater yields from a winter-growing legume and a summer-growing grass was mentioned.

+ Fertilization - Requirements and Cost for Maintenance of Pure Grass Sod - G. B. Killinger, Fla. Agric. Expt. Station, Gainesville, Fla.

It would be most difficult and quite unlikely that anyone could cover the subject of Fertilization - Requirements and Cost for Maintenance of Pure Grass Sod in twenty to thirty minutes. Certainly some of the statements made concerning the topic are controversial - in fact, some of you may take violent exception.

This we know and it should not be questioned -- or at least not much. Fertilization - yes, we need more of it; more acres in the South have not than have seen or felt fertilization, or at least much fertilization.

Seriously, certain grasses require more nutrients for their growth and well being than others; likewise, some grasses can utilize more or are more efficient in the use of fertilizer materials. Two such grasses are Coastal Bermuda, developed at the Georgia Coastal Plain Experiment Station by Dr. Glenn Burton, and Pangola grass introduced through the U. S. Department of Agriculture and developed by Mr. George Ritchey of the Florida Agricultural Experiment Station. There are a number of such grasses which can profitably use more nitrogen, phosphorus, potassium, calcium and sometimes minor elements than such grasses as Common Bermuda and carpet grass. At the Gainesville Station it was found that Coastal Bermuda would produce four to five times as much forage of equal quality as Common Bermuda, both grasses fertilized alike. Pangola outyielded carpetgrass three to four times under like fertilization.

The topic being discussed at this time pertains to pure grass sods -- no legumes. I believe most of us have found it profitable to include legumes in grass sods where they are adapted. Naturally, a grass-legume mixture is a different deal from the standpoint of fertilization. Drs. Wagner and Leasure will undoubtedly touch on this later this afternoon.

A valuable contribution to southern pastures would be made if we knew the optimum levels of nutrients required for each grass species. Varieties within a species may even vary.

Dr. Burton, of Tifton, reports that data to date with Coastal Bermuda indicate optimum growth when the forage contains 0.2% phosphorus and 0.8 to 1% potassium. When potassium fell to 0.6% the yield declined 12%. Coastal Bermuda grass does not consume potassium or phosphorus in luxury quantities as has been reported for many of the northern grasses. Experiments in Georgia show Coastal and Suwanee Bermuda recover nearly twice as much nitrogen and significantly more phosphorus and potassium than Common Bermuda. When Bermuda grass is to be used for hay, and at least 200 pounds of nitrogen per acre is applied, a 4-1-2 fertilizer ratio is suggested on the basis of a factorial experiment under way in Georgia. The Florida Station workers have found Pangola grass responsive to nitrogen applications up to 240 pounds per acre; more may be needed under special conditions. Pangola grass is a luxury consumer of potassium with forage compositions of 0.7 to 1.5% potassium. Actually, no increase in forage yield has been noted when potassium exceeds 0.7 to 0.8%. Plant phosphorus levels of 0.25 to 0.35 appear to be optimum for Pangola growth. Several bits of data have indicated that when the potassium content of a forage is high there is a likelihood for the plant calcium to be low. This may not be good. Clovers, particularly, show this phenomenon. However, grasses exhibit the same tendency. One 3-ton (dry) cutting of Pangola hay has been found to contain all of the nitrogen, phosphorus and potassium contained in 500 pounds of a 6-6-6 fertilizer. Yes, Coastal Bermuda and Pangola grasses can and do effectively use plant nutrients.

So much for two very popular grasses in the South. There are other grasses - perhaps a larger acreage of them - than these two. Texas and Oklahoma alone have more species than we can discuss today.

W. W. Woodhouse and D. S. Chamblee, of the North Carolina Station, state that fescue, orchardgrass, Bermuda grass and Kentucky bluegrass grown in pure stands require very high and frequent nitrogen applications for good grass yields. When establishing new stands, 500 to 800 pounds of a complete fertilizer such as 8-8-8 should be applied. A total of 100 to 400 pounds of elemental nitrogen annually is required to obtain maximum yields from pure grass sods, depending on the species used and the soil (3 to 5 tons of dry forage can be produced under this fertilization).

Coastal Bermuda (Wake County, N. C.)
Nitrogen applied April 15 & June 15

0 - 0	Yield	3597 lbs.	forage containing	47# N
25 - 25	"	6486	" "	95# N
50 - 50	"	9208	" "	165# N

Kentucky 31 fescue - orchardgrass mixture in Virginia showed yields of 2328 pounds with no nitrogen to 4059 pounds with 100 pounds of nitrogen.

A factorial experiment is now under way at Gainesville, Florida, with Coastal Bermuda and Pangola grass treated with nitrogen rates of 0 to 1561 pounds per acre, phosphoric acid at 45 to 315 pounds, and potash at 76 to 531 pounds per acre.

It is quite evident when one reviews the recent literature on pure grass sod fertilization that there is a wide variance in opinions of nutrient requirements for the various grasses. It appears that much research in the past has dwelt only with minimum and moderate levels of nutrition. The actual requirements of any specific grass have not been accurately determined, and much more research is needed along this line. Certainly, a great deal has been done with nitrogen rates, but in many cases phosphorus, potassium, calcium, magnesium and the minor elements have not been recognized. At least, ratios or proper combinations have not been worked out thoroughly.

Certainly, the grass species, soil and temperature all combine to influence fertilization. More important than these, however, are (1) management, and (2) rainfall or irrigation.

Regardless of fertilization, poor management can break a pasture program. What the high economic peak is on fertilization cannot be determined without water control (irrigation or drainage). Researchers are varied in their opinions of phosphorus and potassium required by grass sods. Probably most will agree that good grass sods can be maintained on soils having a pH of 5.5 to 6.5. One hundred to 150 pounds of nitrogen per acre per year would be about an average peak if irrigation is not considered - \$15.00 - \$20.00.

40 to 60 pounds of P_2O_5	-	2.00	-	3.00
60 to 80 " " K_2O	-	4.00	-	5.00

Without lime or minor elements this would total \$21 to \$28 per acre a year.

Good grass sod fertilization can be practiced for \$15 to \$20 per acre and \$5 per acre will allow for chopping or several mowings to keep the vegetation in good condition.

Tailor grass fertilization to fit the feed requirement. One pound of quality forage in September or October may be worth 5 or, yes, 10 pounds of quality forage in May or June. Certainly, a return of 2 pounds of beef from one pound of nitrogen as reported by Georgia is good - N may vary from 10 to 20 cents per pound.

What the requirements are? - - I don't believe anyone knows.

What the cost of maintenance is for pure grass sods? - - This can vary several hundred percent.

DISCUSSION:

Chamblee called attention to an apparent situation in orchardgrass and Kentucky fescue in which the K_2O content in pure stands of this species was not high as in mixtures.

DeVane: Stated that repeated tests of Coastal Bermuda have shown that the species is not a luxury consumer of K_2O .

The Use of Pure Grass Pastures in Certain European Countries

W. W. Woodhouse, Jr., N. Car. Agric. Expt. Station, Raleigh, N. Car.

The Netherlands is the only country in Northwestern Europe in which pure grass sods predominate and which depends primarily upon this type of sward for the support of its livestock. There is a tendency in this direction in several of the other countries, notably Norway and Belgium.

The reasons for the all-grass Dutch pastures may be summarized as follows:

1. Most of their grassland is permanent - never plowed.
2. Much of it is on peats, sands and heavy clays, that, with the present state of knowledge, should not be plowed once they are sodded over.
3. The Dutch have not been able to devise any workable scheme whereby productive legumes can be introduced and maintained in these permanent sods.
4. Well distributed rainfall, a cool climate, plus water control (sub-irrigation) on many pastures, makes the response of grass to nitrogen fertilization throughout the growing season particularly attractive.
5. The small size of farm, the fact that many farms are 100% grassland and since the war, the restrictions on imported feeds makes it essential that the farmer get a heavy yield of high quality forage from his permanent pastures. Consequently, nitrogen fertilization is almost universal and by our standards, quite liberal.

DISCUSSION:

Leasure: How high is the production in the Netherlands?

Woodhouse: Estimates given show the equivalent of 4700 pounds of barley per acre. Two thirds of the milk is produced in summer, one third under barn feeding.

Neel: Do they get a lot of N from barnyard manure?

Woodhouse: Much of the N is from barnyard manure. All solids are conserved and some conserve both liquids and solids. Those who save both do not buy any N fertilizer. Most of the Netherlands farmers buy about one-half of the required N.

Dr. Chamblee asked R. E. Blaser, Virginia, for comments.

Dr. Blaser, in a brief discussion pointed out that the most important criterion is the animal. Intake and digestibility cannot be stressed too much. For a steer to make a 2 lb. gain, 150 lbs. of forage must be consumed. Slightly better gains have been secured when a legume is used. Rates of gain of .99, 1.13, 1.12 and 1.3 were obtained from fescue plus N, Ladino, orchard plus N and orchard and Ladino, respectively. Dairy cows produce better on legume or legume-grass mixture than on pure grass sods.

Gardner: Will cooler climates result in better quality forages in Virginia than in the Southeast?

Blaser: Cool growing temperatures certainly affect quality, however, good gains are secured in summer.

How to Shift or Maintain the Legume-grass Balance

X Influence of Management on the Legume-grass Balance X

R. E. Wagner, Forage and Range Section, ARS, Beltsville, Md.

Maintaining desirable proportions of legumes in pastures is a major grassland problem and is a function of several factors.

Grasses and legumes growing together are constantly competing for space, light, water, and plant nutrients. These, together with soil and air temperatures, humidity, insects and diseases, are the principal environmental factors determining the performance of a growing plant. Within the broad limits set by nature, a powerful factor in forage plant performance is grazing or cutting management. Grazing or cutting, depending upon how it is regulated, may be either detrimental or beneficial to the persistence, total yield, distribution of production, botanical composition and feeding value of the mixture.

Knowledge of the effects of different intensities and times of defoliation on the development of forage plants is essential to good grazing and hay practices. Because of the diversity of growth characteristics of pasture and hay plants, the management requirements for best establishment and optimum growth of various species differ markedly. Habit and rate of growth, season of maximum production, and length of the period over which active growth occurs are all important factors in the reaction of a species, variety, or strain to grazing or cutting. Grasses ordinarily require different management practices than legumes. Different grass species or different legume species in many cases respond differently to defoliation treatments. Even strains within the same species of grass or legume often must be managed differently in order to assure maximum production and survival.

Problems in management are complicated by the fact that grasses and legumes are normally seeded in mixtures for pasture in the humid regions. Frequently, the treatment that would be best for any one of the component species of a mixture is not best for the mixture as a whole. Thus proper management of a given species growing in mixture with other plants may be quite different from proper management of the same species growing alone. In some mixtures it may be necessary to abuse the grass in order to maintain the legume. Less frequently, the grass must be favored.

Because of the usual surplus of growth in the spring of the year it is often desirable to harvest the first crop of taller growing mixtures such as orchardgrass-Ladino clover or brome grass-Ladino clover, as hay or silage. This practice has frequently been reported to be responsible for considerable thinning of the Ladino clover because of delay in removal of the early spring growth.

Studies were conducted at Beltsville, Maryland, during the 3-year period 1947-49 to determine the effects of different times of beginning clipping in the spring and of different frequencies of harvesting the aftermath growth on the grass-legume balance throughout the growing season(5). Four different mixtures were used, including orchardgrass-Ladino clover, brome grass-Ladino clover, orchardgrass-alfalfa, and brome grass-alfalfa. The three dates of beginning cutting in the spring were approximately April 20, May 5 and May 25. Aftermath cuttings were made at frequent and infrequent intervals, the former being time enough for the material to recover to a 6-inch height and the latter being about twice that period of time.

Clipping treatments were initiated in 1947 and trends in botanical composition through the season were followed in detail through 1948 and 1949. Early in the season of 1948 Ladino clover composed a comparatively small part of the herbage from plots of all treatments of orchardgrass-

Ladino clover. In the last 1948 harvest the May 5 cutting series (clipped infrequently) and the April 20 and May 5 series (clipped frequently) had from 51 to 61 percent Ladino clover whereas all other treatments contained from 37 to 42 percent Ladino clover.

In the spring of 1949 the frequently clipped plots that were harvested first in April contained a considerably higher proportion of Ladino clover and less orchardgrass than any other treatment. Dry weather late in the summer reduced the percentage of clover considerably on all plots, but a greater proportion remained on the frequently clipped plots than on those clipped infrequently. On frequently clipped areas, the percentage of orchardgrass increased as the time of beginning clipping in the spring was delayed.

The trends in botanical composition of the brome grass-Ladino clover plots during the summers of 1948 and 1949 were influenced by both frequency of harvest and time of first cutting in the spring. Generally, the problem with this mixture was the maintenance of brome grass rather than Ladino clover. In the first cuttings of 1948 brome grass predominated except where harvesting began in early May. It is significant that under this treatment brome grass composed less than 25 percent of the herbage regardless of frequency of aftermath harvest. All other treatments contained from 51 to 70 percent brome grass.

Under frequent cuttings the percentage of brome grass declined sharply and that of Ladino clover increased following the first harvest. Under infrequent cutting, the proportion of brome grass decreased much less sharply. Weeds made up a substantial part of the herbage harvested in 1948 from the latter part of July until late in the season on all the frequently cut plots and on the plots cut first in early May in the infrequently harvested series.

From the first harvests of 1949, the percentage of brome grass on the frequently cut plots was low except where the first harvest was delayed until May 25, in which case brome grass comprised 56 percent of the harvested herbage. By fall of that year very little brome grass remained on any of the frequently cut plots regardless of the time of beginning cutting in the spring. Under the infrequent cutting system, plots harvested first on May 5 contained only 19 percent brome in the first spring cuttings compared to 41 and 68 percent for plots first harvested on April 20 and May 25, respectively. In the fall of the year relatively good stands of both brome grass and Ladino clover remained on the infrequently clipped plots except where cutting started on May 5, in which case weeds were a problem.

In the alfalfa mixtures given frequent cutting the alfalfa component was almost eliminated in a single year. Where the aftermath was permitted to grow to a height of 12 inches before defoliation, alfalfa formed about the same percentage of the herbage at the end of the three years as at the beginning. The percentage of alfalfa on these plots increased with a delay in time of first harvest in the spring.

Sprague and Garber(3) reported that removal of the first crops in the spring of orchardgrass-Ladino clover and brome grass-Ladino clover when 8 to 10 inches high and of the subsequent growth when it was about 8 inches high provided good yields and also maintained the stand of clover better than later cuttings at the early head or full bloom stages of growth of the grass. A 2-inch height of cut was more satisfactory than a 3-inch height.

Sprague, et al., (4) reported that by a careful management system of grazing alfalfa only when it had recovered to the bloom stage, and for a period of only a week or 10 days, no plants were lost due to grazing during the 5 years of the experiment.

Working with mixtures of orchardgrass-Ladino clover and timothy-Ladino clover, Brown (1) found that regardless of height when cut, mowing 2 inches above the ground resulted in three times as much Ladino and 10 percent higher yields than setting the mower to leave a 4-inch stubble. The most clover (62 percent in 1949) occurred when the mowing was done when the crop was 10 inches high and then mowed 2 inches above the ground. The 8- to 2-inch system with 55 percent Ladino in 1949 was nearly equal to the "10- to 2-inch" cuttings. Delaying the first cutting of the season until June 1 for the orchardgrass-Ladino clover mixture and to June 15 for the timothy-Ladino clover seeding, with subsequent mowings when 6 inches high and cut back to 2 inches above the ground, was a high clover, large yielding system.

Pierre and Jackobs (2) found a marked difference between the New York and Italian strains of birdsfoot trefoil in their ability to survive different cutting treatments. New York birdsfoot trefoil maintained good stands over a 2-year period under a wide variety of cutting treatments, except for cutting at maturity. When cut at this stage there was some reduction in stand. On the other hand, the stand of Italian birdsfoot was reduced as a result of close, frequent, and late fall cuttings during the same period. Both strains survived the effect of cutting every 3 weeks to a height of 4 inches, or cutting at pre-bloom, 1/10-bloom, and full bloom. Italian birdsfoot survived the effect of cutting at maturity.

In any pasture management program, grazing or cutting practices obviously should be those that favor the problem species. Most often this is the legume, although it may be the grass, depending upon the mixture involved and soil and climatic conditions under which they are grown. The dual use of grass-legume mixtures for hay or silage in the spring followed by summer pasturing can be effectively practiced, but the date of first cutting in the spring, the height at which herbage is removed, and the frequency of removal must be carefully manipulated in order to maintain a desirable grass-legume balance. In mixtures of tall growing grasses with relatively shorter growing legumes, such as orchardgrass-Ladino clover associations, it is especially important to harvest the silage crop earlier than is commonly practiced by farmers to favor persistence of the legume. In mixtures involving alfalfa, allowing for recovery to the bloom stage before each grazing through the season appears to be of prime importance.

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DISCUSSION:

Chamblee: Is it not true that tall fescue is considered to be less palatable in the Northeastern States?

Wagner: This is generally true, however, cattle in the area are barn fed in winter and are on the pastures less than in the South. Time of year that fescue is grazed is an important factor in relation to palatability.

Leasure: How serious is fescue foot?

Blaser: Two animals on one farm were found to have fescue foot.

Brown: Animals with fescue foot were reported on two Missouri farms. On both farms, cattle were in poor condition with no legume in the mixture. If farmers watch their animals, injury is lessened.

Leasure: He pointed out that animals on fescue do not make as good gains as on orchardgrass. Animals on fescue have a rough coat and the question was asked if this is an early symptom of fescue foot, and might it not be costing the farmer more than is now indicated.

No answer.

Brown noted that their cases of fescue foot were reported in the spring as well as in the fall. Killinger stated that animals on tall fescue were most likely to show molybdenum toxicity.

Woodhouse, N.C.: Have not had any fescue foot. Relatively good gains have been secured with beef calves on fescue, 1.39 lbs. in spring and summer and 1.09 lbs. in fall and winter. No good for milk production.

Influence of Fertilization on Legume-grass Balance

J. K. Leasure, Tenn. Agr. Exp. Station, Knoxville, Tenn.

Many samples of the influence of fertilizers on the legume-grass balance have been given in the preceding reports. In Tennessee, experiments have been conducted on widely different soil types in which N, P, and K have been varied. Grass-legume mixtures under this condition have responded quite differently on the different soil types.

With initial applications of 50# of N, 200# of P_2O_5 and 120# of K_2O and with annual applications of 100# N (split), 60 lbs. P_2O_5 and 60# K_2O , some locations have developed almost pure stands of grass; a few pure legume stands and only one or two have retained anything near a grass-legume balance. The results indicate that we do not yet know how to maintain grass-legume balances by means of fertilizers.

The results do indicate the need for greater knowledge of the soils in question. Dr. Leasure also pointed out that according to reports from the fertilizer industries, substantial reductions in acreages of most crops grown in Tennessee can be made without reducing total production through the proper use of fertilizers. The opinion was expressed that until we are pressed for the thorough detailed research, the answers to many of our forage problems would not be forthcoming.

Wednesday, June 9

8:00 AM Field Tour to the Agronomy and Perkins Farms, by Bus.

The tour was conducted by Jack Harlan and Cliff Elder and assisted by other members of the Oklahoma Station staff. Special apparatus and equipment adapted to particular problems were observed. Nurseries of introduced grasses and legumes and pasture studies of Bermuda, alfalfa with fescue and with brome, and the temporary winter pastures of hairy vetch with barley and with oats were observed and discussed at the Agronomy Farm.

At the Perkins Farm, extensive breeding nurseries of western and other grasses and an alfalfa nursery were observed. Also noted were most of the uniform variety tests of grasses and legumes. Pasture trials involving Bermuda and weeping lovegrass were observed while a temporary vetch and rye winter trial had been concluded.

1:30 PM Section I, Plant Breeding, Session 2. - J. R. Harlan, Chairman

Breeding for Disease Resistance in Forage Crops

X Selecting for Resistance to Virus Mosaic in Ladino Clover X
/K. W. Kreitlow/ Forage & Range Section, ARS, Beltsville, Md.

One of the major weaknesses of Ladino clover is its susceptibility to a number of virus diseases. At Beltsville, Maryland, a nursery of 3000 spaced plants comprising Ladino clover from many domestic and foreign sources was observed to show apparent differences in virus infection. During the growing season of 1952 all plants in the nursery were checked visually for symptoms of virus infection. Those showing no symptoms were marked and later divided and part of each clone was transplanted to a greenhouse and the remainder to a new nursery. A total of 106 plants from the original 3000 were selected. In greenhouse tests and observations, all but 14 ultimately developed symptoms of virus infection. Of the 14 remaining plants, 2 were found to be free of virus. By artificial inoculation tests, both clones appear to possess resistance to bean yellow mosaic virus but they are moderately susceptible to alfalfa mosaic virus. Both viruses are widespread in Ladino clover and occur either individually or in combination in a single plant.

✓ Does Disease Resistance Affect Forage Quality? ✓- /G. W. Burton/
Coastal Plain Expt. Station, Tifton, Ga.

The substance of Dr. Burton's remarks is covered in a note published by him entitled: Does Disease Resistance Affect Forage Quality, Agron. Jour. 46(2): 99. 1954.

DISCUSSION:

- Burton: If disease resistance does not affect yield we aren't too concerned, however, I may be wrong. In Sudan, diseases decreased protein 9% and increased lignin. Examples of the effects of diseases were given.
- Keller: Water requirements increased on diseased plants.
- Beard: Anthracnose on red clover lowered hay grade.
- Kreitlow: Slugs ate all of the smut out of bluegrass leaves.
- Anderson: Cattle ate stem rust.
- Stitt: Dodder on lespedeza reduced lespedeza yields but total yields were good.
- Anderson: Bromegrass was badly infected with *Helminthosporium*. Cattle refused to graze it.
- Kreitlow: Sooty blotch reduced yields in crimson clover and rust reduced carotene content in white clover.
- Law: California brome takes head smut and is susceptible to the 4 races.
- Kreitlow: Crown rust is hard on domestic ryegrass. The Uruguay introduction carried high resistance to rust. Plants are variable as to type and susceptible to crown rust. Work is under way in Miss., Ala., Ga., and Fla. It looks as though we will come up on a rust resistant ryegrass in a few years.
- Holt: Material from Uruguay was planted in the nursery with a susceptible material. Tried a selfing program and was successful. Have not been able to get complete resistance as plants are still segregating. Other races may be involved. A reseeding annual is needed in South Texas. Too often rust causes seed failures.
- Bennett: Rust came before flowering and infected plants were rogued. We were able to self some at State College. We have lines which look good and have inoculated some in the greenhouse and found a high percent resistant. Resistant plants were taken to the field and many look good. At the North Miss. Station at Holly Springs, reseeding ryegrass and crimson clover have been utilized the fourth consecutive year for winter grazing.
- Hogg: The Chapel Hill strain of rescuegrass was infected with smut 100%. Some of the Uruguay strains look good.
- Burton: Westerwold ryegrass from Holland is very productive but is susceptible to rust. Seedlings were inoculated in the greenhouse and 4 clones were carried through the summer. Seed were produced and seedling plants were reinoculated. Resistant plants were saved

and transplanted to the field. Dry weather is injuring plants at the present time, so few seed are being produced.

Kreitlow: Inoculation techniques need to be improved. The use of dry, ground inoculum appears promising. This can be stored for relatively long periods of time. Better techniques are needed before problems can be solved.

X Breeding for Disease Resistance in Mountain Brome and Crested Wheatgrass X A. G. Law, Wash. Agric. Expt. Station, Pullman, Wash.

Kreizinger, et al., (J. Agr. Res. 75:3, 1947) reported the results of controlled inoculation tests of 14 accessions of Bromus marginatus with four races of Ustilago bullata. Average percent smut in these tests ranged from 0.2 on Wn 439 to 71.3 on P 1841. There were no marked differences in virulence of the four races of head smut.

As a result of these tests, coupled with agronomic evaluations, Wn 439 (P3368) was increased and released as Bromar in 1946. Certified seed fields of Bromar were grown principally in the Spokane, Wash., area. In 1951, reports were received of severe head smut infection in several seed fields.

Dr. J. P. Meiners (USDA pathologist), after extensive tests with smut collections from the certified fields, concluded that a new race of Ustilago bullata had appeared that was extremely virulent not only on accessions susceptible to the original four races, but also on Bromar.

In 1949 Comstock had initiated an extensive hybridization program between accessions of B. marginatus aimed toward elimination of the undesirable awn characteristic of Bromar.

The F₂ material was screened through the available four races of Ustilago in 1950-51 with the following results:

Summary of percent smut in B. marginatus
1951 data

	Smut race				Range in % infected	
	5	7	9	12		
12 F ₂ lines	26	38	21	32	3%	54%
Parental lines	16	22	12	18	0.6%*	45%
* Wn 439 (Bromar)						

In 1952 and 1953 selections from Wn 439 were inoculated with the new Bromar race with the following results:

	Percent smut of Wn 439 using "Bromar" race					
	1952			1953		
	No. plants	Avg.	Range	No. plants	Avg.	Range
10 F ₃ lines from Wn 439	4400	28%	11-41	2000	87%	84-93

Following these results native collections of Bromus marginatus were made as well as selections in Wn 439 that were smut-free in 1953. These are being tested now. It must be pointed out, of course, that all is not lost since seed treatment with Ceresan M., Arasan and Panogen at recommended rates does a good job of controlling all races of U. bullata in seed fields.

Stem smut is widespread throughout the Pacific Northwest, occurring on a number of genera of Hordeae. It is perhaps most common on Agropyron repens and Elymus glauca in the Palouse area (Fischer, Wash. Agr. Exp. Sta. Bul. 459). It occurs commonly in old stands of Agropyron desertorum. Twenty-one selections from a source nursery established by D. C. Smith in 1947 were planted out on an individual plant basis in 1949 and inoculated in 1949 and 1950 with a spore suspension of U. spengazzinii. In 1951 and 1952 infected plants were rogued out and in 1953 the remaining plants were allowed to interpollinate and seed was collected. This material is being tested further for resistance to stem smut and for yield and other agronomic characteristics.

Methodology, Techniques, Gadgets and Gimmicks

x Exakta Camera - E. C. Bashaw, Agr. Exp. Station, College Station, Tex.

This camera is a single-lens, reflex, 35 mm camera with wide versatility for taking photographs at normal distances or for extreme closeups. The particular application discussed here was its adaptation for photomicrography. By means of an adapter and collar, the camera can be easily attached to a monocular tube of a microscope. By introducing a bellows attachment between the collar and camera body, suitable enlargement of pollen mother cells, chromosomes or other objects could be magnified to completely fill a frame of 35 mm film. Slides illustrating the equipment and results obtained were shown. In addition, slides were shown illustrating the use of close-up photography with the Exakta to magnify disease lesions on plant material.

✓
/ Sudangrass Leaf Blight Inoculation - R. C. Pickett, Agr. Expt. Station, Manhattan, Kans.

Seedling inoculation of Helminthosporium turcicum on sudangrass lines was made in the greenhouse at Manhattan for the last 3 winters. Significant differences along lines in disease reaction in the greenhouse were found each year.

A large number of lines were handled. It was possible to screen all lines to be considered for field planting each year.

Three-inch pots were used with seedlings thinned to 5 per pot. The optimum age of seedlings at inoculation time was 6 weeks. The average incubation period until disease notes were taken was 21 days. If younger material was used, 23 or 24 days incubation was better.

A double canvas wall moist chamber was used. The Helminthosporium turcicum spores in aqueous suspension were sprayed on the leaves. Plants were left in the chamber for 48 hours as an optimum.

Three replications were used and check varieties were put in each chamber. No evidence has yet appeared to indicate that there were different races of Helminthosporium among the isolations used.

A good by-product of disease screening is the detection of lines with deficient germination.

The correlation of greenhouse disease reaction with field reaction is essentially unknown as yet since the last two nurseries have had little disease. The only correlation coefficient calculated to date is + .194* for 112 comparisons. The field disease was far less severe.

✓
X A Powered Belt Seeder X - R. E. Stitt, USDA & Mont. Agric. Expt. Station, Bozeman, Mont.

Dr. Stitt reported on the difficulty of getting stands of nursery and small plot trials by conventional methods. As a result, they have developed a belt seeder powered by a Jari mower. A cover over the belt is attached to the seeder so that seeding can be made on windy days. Even with such a seeder, grass seed, particularly of most western species, should be processed before seeding. Single and multiple belt planters are being used at a number of branch stations in Montana.

A general discussion developed on the needs for still better methods of handling large numbers of plots with little labor. Dr. Kalton, of Iowa, reported on labor-saving methods being used in the bromegrass breeding program. The use of 5x8-foot plots, adequately replicated, has reduced labor needs materially without affecting the reliability of results.

✓
X A Forage Harvester X - F. P. Gardner, Ga. Agric. Expt. Station, Athens, Ga.

Some of the difficulties in harvesting small pasture plots have been overcome by a collecting pan that collects the herbage simultaneously with mowing. The pan is constructed from sheet metal, is simple and inexpensive to make. No reel is needed as the forward motion of the mower against the standing grass forces the herbage into the pan with essentially no loss of plant material or collection of debris. The herbage is bagged or weighed at the end of the plot after disengaging the blade. It is estimated that a collecting pan of this type reduces harvesting time by approximately 50% and at the same time increases the accuracy of sampling.

"and other articles too numerous to mention".

x Native Grassland Evaluation - (K. L. Anderson, Agric. Expt. Station,
Manhattan, Kans.

Species composition as related to site serves as a major criterion for evaluating range condition, the climax or ecological equilibrium for a given site being considered as the 100% level of condition. Departure from this normal indicates declining condition and thus, the aim of management is to promote secondary succession.

Preliminary phases of grazing research at Kansas State College included a study of species population as related to site in order to establish a basis for evaluating condition and trend. Detailed mapping of the soil conditions provided an opportunity to relate vegetative composition to site. Fifteen soil sites were delineated by survey but statistical examination of the plant population samples showed that only 5 upland and one lowland range sites could be recognized.

1. Ordinary uplands - represented by the regional climax.
2. Limestone breaks site - also represented by the regional climax but somewhat droughtier because of moisture loss due to steeper terrain.
3. Clay uplands - droughty because of reduced permeability, hence supporting a preclimax vegetation.
4. Very shallow - droughty because of the presence of massive limestone near surface, hence preclimax vegetation.
5. Claypan site - thin soil over dense clay, hence very droughty. Vegetation is preclimax.
6. Lowland (gullied) - variable due to erosion.

Relating vegetation to site in this study can serve as a basis for vegetation surveys in Flint Hills pastures as these sites are representative of some 4,000,000 acres of range land in that part of Kansas.

x Problems in the Use of Forage as a Feed for Livestock That May Affect Forage Evaluation - (M. E. McCullough, Ga. Agric. Expt. Station, Experiment, Ga.

The often repeated observation that "everyone looks for a Utopia" apparently also applies to scientists trying to evaluate forages in terms of animal production. The dream of finding some one simple measure that will correlate with animal production over a wide range of conditions is still with us despite the ever broadening knowledge of the factors affecting both plant and animal responses.

Forage evaluation must be considered as having two distinct areas of interest, viz. (1) yield of animal products per unit of forage and (2) the fundamental reasons for differences between yields. While there are many problems concerned with item 1, it must be evident that such an evaluation is much simpler than item 2.

When a ration is fed to an animal the quantity and quality of animal products produced depends to a great extent on four factors (1) quantity fed (2) balance of the ration nutrients fed (3) presence or absence of metabolic stimulators, and (4) efficiency of nutrient conversion into animal product. Obviously the four items are interwoven in their action. The quantity of the ration fed either reduces or exaggerates the effects of ration balance. The presence of a metabolic stimulator increases the efficiency of conversion and reduces the quantity of feed required per unit of desired response. An excellent sample of this is the milk stimulating ability of small amounts of winter oat forage.

The most needed technique is one which will permit the assignment of a numerical value to the balance of nutrients offered by a given quantity of forage. The present practice of using a forage nutrient or nutrients as indicators of ration value is obviously of limited value.

Balance of Ration

The data in Figure 2 is from work by Forbes with rats (J. Nutrition 1938) and summarizes two experiments in which equi-calorie diets were fed with varying levels of protein. Of interest is the decrease in body gain at high levels of protein feeding and the difference in storage of fat and protein between the 15% and 25% level of protein. The higher intake of protein (Experiment) apparently increased protein storage and accounts for the rapid increase in body gain. Brody has pointed out that one gram of protein gain is associated with three grams of water gain whereas one gram of fat is not so associated with water. Moreover, the energy equivalent of one gram of fat is $2\frac{1}{2}$ times that on one gram of protein. Hence, one gram fat gain is calorically equivalent to about 8 grams protein gain (including associated water).

Factors affecting efficiency of TDN utilization. (Calf Experiments, Ga.)

1. Calves fed for a high rate of gain. (112% normal)

- a. Milk - 10% of body weight to 12 weeks, limited grain and hay. Required 1.50 lb. TDN and 0.31 lb. Dig. Protein per pound of gain.
- b. Milk - 10% of body weight to 6 weeks, ad lib. hay and grain. Required 2.50 lb. TDN and 0.56 lb. Dig. Protein per pound of gain.

2. Calves fed for a limited rate of gain. (85% normal) (Vermont)

All calves fed milk at the rate of 10% of their body weight for 6 weeks.
All calves fed grain at the same rate.

- a. Good hay - 1.79 lb. TDN and .40 lb. DP per one pound of gain.
- b. Good hay plus cod liver oil - 1.52 lb. TDN and .37 lb. DP per pound of gain.
- c. Poor hay - 1.97 lb. TDN and .45 lb. DP per one pound of gain.
- d. Poor hay plus cod liver oil - 2.06 lb. TDN and .46 lb. DP per pound of gain.

Measuring Forage Quality

Within the limitations of present measures, certain general means are available for measuring the factors in forage which affect animal production. The complications which arise due to the selective grazing practiced by the free-grazing animal are many and difficult to rectify. However, in general, increasing forage quality is accompanied by greater intake of energy, protein, minerals and other nutrients and is accompanied by increased animal production. This increase may or may not be accompanied by increased efficiency of conversion of nutrients. Indeed, it would seem, at the higher levels of quality at least, that it is not. For this reason, so long as the animal is presented with adequate forage which does not within itself limit intake, the factors involved in forage evaluation are rather closely related to the per unit concentration of nutrients as measured by digestibility. As yet no satisfactory formula has been developed which permits the estimation of forage value from forage digestibility except on a within-forage basis. Even on a within-forage basis, differences are measurable only between widely differing areas. Thus, a difference of 5% in dry matter digestibility may result in measurable differences in animal response, but differences of 1 or 2% cannot be detected.

The use of several factors in the evaluation has many advantages. McCullough has estimated the general correlation between dry matter digestibility and persistency of milk production to be around .4 to .5. The correlation of persistency and forage protein is about the same magnitude. However, by holding forage protein constant, the partial correlation between dry matter digestibility and milk persistency has been increased to .86.

Since increases in forage digestibility are usually accompanied by an increase in forage intake, (this increase has averaged about 2 lb. dry matter for each 1% digestibility in our studies), little has been gained by intake determinations except in forages which limit intake.

It is suggested that future work in this challenging field should emphasize efforts in three areas of investigation:

- (1) A measure of ration balance which can be expressed numerically.
- (2) A measure of relative per unit concentration of nutrients which is more descriptive than T.D.N.
- (3) The relative change in items 1 and 2 per unit change in digestibility.

With the above items of information we may be able to express forage evaluation in a formula something like this:

$$\text{Pounds of milk produced} = Xb_1 + Yb_2 + Zb_3.$$

+ The Evaluation of Western Range Conditions - E. H. Reid,
Colo. Agric. Expt. Station, Ft. Collins, Colo.

Western rangelands vary greatly in such features as the vegetative type, climate, topography, and grazing values. They have many uses, including grazing of domestic livestock, grazing of game animals, watershed protection and timber production. These uses influence the management of the range.

The condition of most western ranges from the standpoint of forage production should be determined primarily by studying the vegetation and soil and the effects of grazing on them. Utilization of the forage plants is one of the principal factors of range use that cause changes in range condition. The changes that occur toward range improvement or deterioration as a result of the kind of utilization received, are the real test of the management. These trends, however, are difficult to detect by observations alone unless the changes are marked or rapid. Longtime records from permanent transect clusters on key areas should be maintained to obtain reliable estimates of trends in range condition.

Poor range and poor livestock conditions and good range and good livestock conditions often go hand in hand. However, livestock condition is not always a reliable criteria for determining range condition. With light grazing and good management, good livestock conditions can often be maintained even on ranges that are in poor condition.

Many experiments have shown that there is an optimum degree of utilization for each vegetative type where the livestock operator obtains the maximum returns over the years. In most studies of grazing intensity this has appeared to approximate the maximum degree of herbage removal that the major forage species can receive and yet remain vigorous.

The whole range management operation affects the returns from livestock grazing. Studies at the Desert Experimental Range in western Utah, for example, have shown that with sheep, good distribution of range grazing, good bedding practices, quiet herding, ample provisions for easily accessible water as well as proper forage utilization improved body weight gains of ewes, increased lamb crops and wool yields, and resulted in higher net average yearly income.

< The Evaluation of Southern Range Conditions > - L. K. Halls, U.S.
Forest Service, Tifton, Ga.

The southern forest range as a grazing resource has been evaluated in terms of land acreage, herbage quality and quantity, and livestock production to varying degrees by landowners, educators, extension personnel and research workers in the South.

Approximately 187 million acres of forest lands can be delineated geographically into the Coastal Plain, Piedmont Plateau, and mountain region from Virginia to Texas and Oklahoma. These can be further subdivided into forest types. Within the Coastal Plain are the longleaf-slash pine (38 million acres), shortleaf-loblolly pine-hardwoods (75 million acres), and bottomland hardwoods (75 million acres). Upland hardwoods (36 million acres) are predominant in the mountains and Piedmont Plateau.

COASTAL PLAIN

From a grazing viewpoint the Coastal Plain is by far the most important area. Forage types which contribute to the grazing value of this area are: wiregrass, bluestem, switchcane, bottomland hardwoods, coastal prairie and marshgrass.

Wiregrass: This leading grazing type coincides with the longleaf-slash pine forests of the Southeast and extends from South Carolina through Georgia and Florida into Alabama. Grazing is confined mainly to upland areas where with frequent burning a combination of wiry, fire-tolerant bunchgrasses has developed. Species which contribute the greater portion of the forage are pine-land threeawn, Curtiss dropseed, various bluestems, carpetgrass, panicums and paspalums. Swamps and lowland areas which are periodically under water burn less frequently. They contribute only a small portion of the total forage but it may be relatively high in certain minerals which help to balance the animal diet.

The low quality of wiregrass herbage has long been recognized as a limiting factor in livestock, mainly beef, production in this type. Except for two or three months during the year, wiregrass herbage is generally deficient in protein, phosphorus and calcium. Winter burning for improvement is a common practice, and it is generally recognized that this increases the availability, palatability, and nutritive value of this herbage during late winter and early spring months. Even after burning, crude protein content of the herbage seldom exceeds 10 percent and for most of the year is below 7 percent, the recognized minimum requirement of dry cows. Phosphorus is generally below the minimum requirements for wet cows (.14 percent), but sufficient (.10 percent) for dry cows during spring and summer. Calcium is always below that required (.23 percent) for wet cows.

Weight changes of beef breeding cows are correlated with forage quality. Gains vary considerably among seasons and according to whether or not cows are suckling calves. Cows with calves generally make some gain in early spring, barely maintain their weight during May and June, lose slightly in summer, then suffer heavy losses during fall and winter if left on the range. Under such management the wet cows generally fail to breed.

Dry cows perform very differently than wet cows on range during spring and summer. Gains of one pound per day may be made during the four-month period from March to June and slight gains continue through the summer. These cows generally breed successfully. As with wet cows, they lose weight rapidly on the range during the fall and winter even when fed one pound of cottonseed meal per head daily.

A cow and calf type of operation is common for beef production in this type. A 50 percent calf crop with weaned calves weighing 250-300 pounds is usual for herds grazing the range most of the year. Even so, supplemental feeding of protein concentrates at the rate of one pound per day during the fall and early winter, and dry lot feeding in late winter are essential to prevent severe death losses.

Year-round supplemental feeding of cottonseed meal will increase the calf crop 8 to 10 percent over a period of years. However, the most pronounced effect of this extra feed is increased calf weight, 65 pounds in recent studies. Economic advantage of this practice is small but may be justified when the better care, ease of rounding up, control of insects and diseases and other benefits are considered.

Grazing capacity varies from 1.5 to 5 acres per cow month and is influenced considerably by timber overstory and density of shrubs. The capacity should be based primarily on yearly grass production on upland areas. This varies from 1500 pounds (oven dry) per acre on ranges with few shrubs and open stands of timber to negligible amounts where dense shrubs and timber prevail. Ample herbage is very important. For instance, on heavily stocked ranges with inadequate herbage in south Georgia, steers averaged approximately 100 pounds gain during the spring and summer. With lighter stocking and ample herbage this gain increased to 200 pounds. On a per acre basis gains may reach 20 pounds on highly productive ranges from March to October.

The value of wiregrass herbage may be increased through integration with other feeds. Practical integration studies at Ona, Florida, have shown that approximately 1.2 acres of improved pasture and 4.6 acres of native range per cow were sufficient for year-round maintenance. Calf crop in a herd maintained by this system was 80 percent with calves weighing 425 pounds at weaning. The native range was particularly important and had a high value during the time of year pastures were least productive. Recent studies in South Georgia, supplementing native range with $\frac{1}{2}$ - to $1\frac{1}{2}$ -acres of improved pasture, increased the calf crop only slightly but calf weaning weights were increased from 360 to 400 and 456 pounds. The net return per weaned calf was approximately \$10.00 greater than for similar animals on range supplemented with cottonseed meal.

Wiregrass herbage reaches its greatest value for breeding herds when its use is integrated with other feeds. Evaluation should be made accordingly.

Bluestem: Next in importance to the wiregrass type but similar in a great many respects, is the bluestem type. This extends from Alabama westward to Texas and Oklahoma and thus is not limited to the range of the longleaf-slash pine forest. It probably is of greatest importance in Louisiana where approximately 10 million acres of pine forest furnish herbage for nearly half the cattle in the state for at least a portion of the year.

Grasses are by far the most abundant forage in this type and provide about 95 percent of the diet. The pineland threeawn and Curtiss dropseed of the wiregrass type are replaced by the bluestem. Carpetgrass and Bermuda grass which grow along roads, trails, and on heavily grazed spots furnish good forage and help lengthen the summer and fall grazing season.

Burning promotes close utilization of the bluestems by removing old, dry rough and promoting earlier growth. It does not, however, significantly increase the nutritive quality of green grass or cattle gains as was indicated for the wiregrass type.

Nutritive value of herbage is also low in this type. Crude protein is adequate (.9%) or above for breeding cows from March through June but inadequate for the rest of the year. For dry cows the adequate period extends through September. Except for April, the phosphorus content of herbage is inadequate for wet cows throughout the year. Calcium, on the other hand, is generally sufficient.

Quantity of herbage produced varies from 1000 to 1200 pounds under open stands of timber but decreases to about 450 pounds underneath dense stands. Grazing capacity thus ranges from 1 to 6 acres per cow month depending upon the amount of grass produced.

Animal production, of course, measures the true value of herbage. This is very low for the bluestem type when the greater portion of the forage is provided by unsupplemental range. Calf crops of 35 percent with a weaned weight of 275-300 pounds, are usual under such conditions. By supplementing the range with limited amounts of improved pasture, field gleanings, hay, and cottonseed during the summer, fall and winter, calf crop can readily be increased to 75 percent with an average weaned calf weight of 350 pounds.

Seasonal cattle gains are similar to those made on wiregrass forage. All cattle gain during the spring season, March 15 to June 25, cows at the rate of 0.8 pounds, calves 1.5 pounds and yearlings 1.3 pounds per day. During the summer cows lose slightly while yearlings and calves make small gains. During the fall and winter periods, cows may lose up to 25 percent of their body weight unless supplied with extra feed.

As with wiregrass, final evaluation of bluestem forage should be in line with rules of good management. (1) Graze the range only for four or five months in spring and early summer. At other times of the year supplemental feeds must be provided to maintain an adequate year-round level of nutrition. (2) The bluestem type should be closely coordinated with the use of improved pasture, otherwise protein concentrates, hay, or field gleanings should be supplied. And finally, (3) Ample available herbage should be provided to graze the proper number of animals.

Cattle can utilize native herbage on the millions of acres of understocked pinelands or planted plantations without damage to trees and return \$1.00 per acre per year for the first several years. This would be reduced to \$.35 or even less eventually. After several years of fire protection and good forest management the decrease in grazable herbage is very rapid and the problem may be met in several ways.

(1) Make available as grazing units large areas which contain several conditions or levels of stocking with trees. Understocked areas are present even under the best of management, and provide herbage for grazing animals.

(2) Develop seeded and fertilized firebreak strips through the forest.

(3) Integrate or replace native herbage with other sources of feed.

Switch cane: Switch cane forms the most productive native grazing type in the coastal plain. It was once widespread throughout the southeast but extensive stands are now largely confined to tidewater lands of the Carolinas and bottomlands of the Mississippi Delta. In Carolina, it occurs typically with pond pine in areas which have been burned periodically. Cane endures prolonged flooding, drought and intense surface fires but is very sensitive to heavy grazing during the summer.

Herbage yields on properly stocked cane areas are high (average about 4500 lbs.) and of good nutritive value. Protein content of herbage during spring and summer is well above the minimum level required for breeding cows and is deficient only during January, February and March. Phosphorus is probably sufficient in most cane areas during the spring, slightly deficient during summer and very low during the fall and winter months. Calcium content is at the required level of 0.23 for most of the year but is highest during the summer and fall months.

The value of cane range in terms of beef cattle production is generally good but rather variable. On good ranges, calf crop has averaged 80 to 90 percent with calves weighing 350 to 400 pounds at weaning. Stocked at 2½ to 3 acres per cow for 7 months such areas have produced a sustained yield of 120 to 130 pounds of beef per acre. Poorer cane areas have produced 100 lbs. of beef per acre and depleted areas as little as 25 pounds per acre.

Cows can be carried profitably on cane range from May to December without supplements other than minerals. With too heavy grazing use, cow weights begin to fall in August but with light use weights can be maintained through November. During the winter and early spring protein concentrates or other feeds are required to prevent excessive weight losses. Mature cattle can be satisfactorily wintered on this type of herbage if given a daily ration of 2 to 4 pounds of a protein feed from January to March.

Condition and productiveness of cane ranges vary considerably but on well managed areas about 3 acres are required to carry a cow from May to December. This may increase to 12 or even 18 acres on ranges in very poor condition. About the same acreage is required per cow for three or four months of winter use as for the six to eight months of spring and summer. Localized areas are highly valued for winter grazing. As such they are much superior to other types and are very important when native range is grazed the year round.

Bottomland hardwoods: Bottomland hardwood forests occur in the Mississippi river delta and swampy areas throughout the Coastal Plain. Although quite extensive, they are relatively unimportant for grazing. Nutritious herbage is provided in these forests where timber stands are fairly open. Although the herbage is most nutritious in spring and summer, the wide variety of grasses, sedges, cane, shrubs, vines, and hardwood sprouts make this type valuable for winter grazing. Grazeable areas in this type serve as a valuable link in the year-round grazing program and may be the main source of feed in certain sections. These areas have a grazing capacity of about 8-12 acres per cow for the winter. Heavier stocking than this in winter and spring must be avoided to minimize damage to seedlings of desirable hardwood species. Its use as a seasonal source of forage and as a link in a year-round grazing schedule provides a more realistic evaluation than do animal gains.

Coastal prairie and marshgrass: These true grasslands border the pinelands and support large cattle operations on a seasonal basis in connection with them. They are generally rather productive and are valued highly by cattlemen. Little research has been done to determine their actual productiveness. Recently some of these treeless areas in Florida have^{been} converted for vegetable production. After one or two years, crop production is abandoned and the land shifted to improved pasture. Without improvement, carpetgrass and or common Bermuda readily invade. The land can be made much more productive, however, by revegetation, fertilization, and good management[†]. These pastures fit in very well on a seasonal basis with the native range. Most of the cattle gains are made on the improved pasture but the native range serves a vital and important link in year-round management.

The fresh water and salt water marsh grass types hug the coast along the southeastern and gulf sections. These areas, long used for grazing, require great skill in management. Methods of living with mosquitos, periodic flooding and burning have been worked out by several generations of residents. These ranges are highly productive. Grazing is the main use and contrasted to other types, there is no timber production. Good seasonal use is made during the winter under a management system which integrates native herbage of the pinelands and improved pastures. Burning in alternate years a month or two before grazing begins and when the ground is wet, and construction of levees and walkways which produce better distribution and enable cattle to get out of the water, are methods of improvement. This type has some of the same general characteristics of other types already mentioned, i.e., generally low quality herbage and need for supplemental feeding during certain times of the year to increase overall productiveness.

PIEDMONT PLATEAU AND MOUNTAIN REGION

These regions are of much less importance for livestock production than the Coastal Plain. They do, however, provide limited grazing. The shortleaf-loblolly pine-hardwood forest of the Piedmont offer a contribution to the yearly forage supply for commercial beef herds and young stock on dairy farms. The herbage, consisting mainly of honeysuckle, broomsedge, and hardwood sprouts, is adequate in protein and minerals for two to three months in the spring and cattle may make reasonably good gains during this time. In open areas where broomsedge is plentiful, or in extensive areas of luxuriant honeysuckle, two acres per cow month are sufficient. As a rule, grazing in the hardwood forests is not recommended because of the possibility of damage to valuable tree species such as yellow poplar and ash, and increased soil erosion. In the uplands primarily suited for pine production, grazing of hardwoods may be beneficial through fire hazard reduction and as a means of controlling vines and hardwood sprouts during regeneration of pine stands.

Consensus of opinion is that grazing in the southern Appalachians is not compatible with good forestry. Forage values in mountain hardwood forests are relatively low and grazing, even when carefully regulated, may destroy desirable tree reproduction, reduce the growth rate of forest trees and damage watershed values. In the Ozark Mountains of Arkansas, there are

sizeable areas of open hardwood forest which have a grazing capacity of 4-6 acres per cow month. Native grass meadows have a higher grazing capacity of 2 acres per cow month. Other land areas now supporting well stocked forest stands and capable of producing commercial timber do not produce enough herbage for more than incidental grazing and therefore probably should not be grazed at all.

SUMMARY

The southern forest range land with its several timber and forage types contribute a partial feed source for the near 20 million cattle in this region and enables thousands of small farmers to own 2- to 3-times as many cattle as could be grazed otherwise.

Major forage types have been evaluated as to extent, herbage quantity and quality, and livestock production. Annual herbage production in the more important Coastal Plain varies from negligible amounts under dense stands of trees to over two tons per acre on highly productive switch cane range. Herbage weight data provide a basis for comparing range types and a method of expressing relationships between timber and herbaceous growth and calculating grazing capacity. Chemical analyses of wiregrass, bluestem, and switch cane forage point to limitations and the inadequacy of native forage to supply adequate year-round nutrition for cattle.

All types have been evaluated to some extent by cattle production. This varies from small seasonal gains in the mountains to 15 or 20 pounds per acre in the wiregrass and bluestem forage types and 120 to 130 pounds per acre in better switch cane range.

Breeding herds provide a more realistic evaluation of the native herbage. Cattle run the year round on unsupplemented native range suffer heavy death losses, low calf crops, and are of poor quality. Greater production is mainly through increased weight and number of calves, reduced death losses and better quality cattle. These can be obtained by providing ample amounts of native forage when quality is highest, supplementing the range when native forage is deficient in essential nutrients, and integration with improved pastures and other home grown feeds. Good management and seasonal use of switch cane, hardwood forests, coastal prairie, and marshland extend the use of native forage and reduce need for supplements.

The actual value of the southern range is difficult to determine. In the final analyses, its true value depends upon our ingenuity and ability to integrate and coordinate its use with timber, pastures and other farm crops. It can be an asset, contribute nothing, or even be a liability. This remains a challenge to the research worker, teacher, extension personnel, and landowners to properly evaluate this resource such that it can fill its proper niche and contribute its rightful share in the overall land use and economy of the South.

WESTERN GRASS BREEDERS WORK PLANNING CONFERENCE

317 Classroom Bldg.

8:30 AM Business Meeting - J. H. Harlan, Stillwater, Okla.

The business meeting was called to order by J. H. Harlan. The first business called for was a report from the nominating committee composed of G. A. Rogler, L. C. Newell, and A. G. Law. Chairman G. A. Rogler presented the following slate of officers:

President - R. E. Stitt
Vice-President - J. K. Patterson
Secretary-Treasurer - R. C. Pickett

He moved that this slate be accepted by the group. The motion was seconded by A. G. Law and passed unanimously.

A. G. Law invited the group to Pullman for their 1955 meeting and moved that his invitation be accepted. This motion was seconded by J. R. Cowan and passed.

Jim Ross invited the group to meet in South Dakota in 1956. This was discussed by the group and tentative plans adopted to accept this invitation. Definite plans will await the approval of the group at their next annual meeting.

G. A. Rogler acted as spokesman for the grass breeders and voiced the appreciation of the group for the facilities provided and the excellent manner with which the program had been presented and field trips managed.

Dr. A. A. Hanson reported on the status of the Uniform Nursery program in the western states. The progress on the uniform nursery program and release of new varieties of grasses was discussed by the various state research workers. Since very few new varieties are presently available, the current plans call for no revision of the present uniform nursery items. Dr. Ritchie Cowan reported on the Western Regional Project W-23. A summary of his report is given later. Activation of the project depends on the allocation of funds.

Dr. D. F. Beard reported on the present outlook regarding Federal funds to augment the State programs.

Drs. E. C. Holt, L. C. Newell, and R. C. Pickett reported on the domestic exploration for native species in their respective areas. Their reports are given later.

Dr. J. R. Harlan reported on the material available at Woodward and Stillwater as a result of domestic and foreign exploration.

Harold W. Cooper discussed the type of program the Soil Conservation Service plans to inaugurate in the Great Plains area as a result of the changes brought about by the closing of the S.C.S. nurseries. The meeting adjourned at 11:50 AM.

Project W-23. ~~X~~ Hay and Pasture Crops for Seed and Forage Production ~~X~~
J. R. Cowan, Oreg. Agr. Exp. Station, Corvallis, Oreg.

Sub-project classification and summary of objectives for
 contributing projects

W-23 Sub-project	Contributing State	Objectives
1 - Seed	Arizona	Influence on winter hardy alfalfa varieties of photoperiod, physiological, cultural and climatic factors in seed production
	Washington	Inter-regional testing with N.E. 10 of alfalfa clones - seed yield on alfalfa as affected by: stand density, reserve food, fertilizer and time of flowering
	Wyoming	Place of growth modifying chemicals in legume seed production
2 - Forage	Colorado	Searching for improved legumes and grasses for Central Great Plains
	Montana	Soil and moisture factors affecting germination and emergence
	Nevada	Growth responses of some stoloniferous legumes under different environments (strawberry clover)
3 - Genetic shift	California	Determine changes (if any) in varieties grown under different environments - possible causes (Pilgrim Ladino clover)
4 -Breeding	Oregon	Use of chromogen to measure digestibility
	Utah	Selecting salt tolerant species for mountain meadow use

~~X~~ Domestic and Foreign Plant Introductions ~~X~~ [✓] E. C. Holt, Texas
 Agr. Exp. Station, College Station, Tex.

Plant collection trips were made in North Central, Western and Southwestern Texas and Northern Mexico in the summer and fall of 1953. The Texas collections were primarily vegetative and the Mexican collections were seed. Approximately 1200 collections were made, largely consisting of Andropogon,

Bouteloua, Panicum and Setaria species. The collections are being increased in cooperation with the Plant Exploration Section and the Regional Plant Introduction Station and will be released through the latter. Some remnant seed are available from the Texas Experiment Station. Additional collections are being made in 1954.

* Report on Domestic Exploration, 1953 - R. C. Pickett, Kans. Agr. Exp. Station, Manhattan, Kans.

In the summer and fall of 1953, four collectors in Kansas collected over 1800 seed lots of native grasses and legumes. The area covered was southern Kansas and Oklahoma. The eastern part of this area was very dry and comparatively little seed was available there. In the central and western part of the area more seed was available, particularly on the sandy sites.

The best germinations and seed were obtained of Panicum virgatum, Sorghastrum nutans, Andropogon hallii, and Eragrostis trichodes. Poor seed and germinations were obtained for Andropogon furcatus, A. scorpiarius, Buchloe dactyloides, Bouteloua gracilis, B. curtipendula, Agropyron smithii and Tripsacum dactyloides. Many native legumes were collected with excellent seed and germinations. This year more collections are being made primarily for Agropyron smithii, Poa arida, and Tripsacum dactyloides.

Over 30,000 grass and 5,000 legume plants of these species were transplanted this spring.

+ Domestic Collections in Nebraska in 1953 - L. C. Newell, Nebr. Agr. Exp. Station, Lincoln, Nebr.

Native and naturalized grasses and legumes were collected throughout Nebraska in 1953. Five principal collectors spent 16 man-weeks and traveled over 12,000 miles in the state during the period from late July to mid-October. During the first part of this season, clones of principal grasses were moved to a clonal observation nursery at Lincoln. As the season progressed, seed of native and naturalized legumes was collected. Included were seed collections of red and alsike clover which had resulted from natural reseeding in native grass meadows, from their initial establishment before the drouth years. Later, numerous seed collections of the warm-season grasses were obtained. In all, over 1000 collections of clones and seed were made of some 60 different species. The most important grass collections included plants and seed of big bluestem, sand bluestem, indiangrass, sand lovegrass, switchgrass, side-ots grama, blue grama, and buffalograss.

For the most part the grasses will be evaluated first at the Nebraska Station by the grass project. Some switchgrass selections have been sent to James Ross at Brookings, S. Dak. The legumes have been turned over to the Miscellaneous Legume Project under the supervision of Dr. T. H. Goodding at the Nebraska Station. Seed of eleven red clovers and five alsike clovers have been sent to the North Platte Substation.

J. K. Leasure, Tenn., Chairman

8:30 AM Report on the Southern Regional Project S-12 - J. K. Leasure,
Tenn. Agr. Exp. Station, Knoxville, Tenn.

Dr. Leasure briefly reviewed the development of the Southern Regional Forage Crops Project S-12. The present project has been revised a number of times, the last being April 1954. The overall project is made up of four subprojects as follows:

1. Pasture and Forage Evaluation Techniques.
2. Breeding Improved Forage Crop Plants for the South.
3. Physiological Responses of Southern Forage Crops to Environmental Variables.
4. Producing, Harvesting, Processing and Storing Forage Crop Seed.

At the June 1953 meeting of the Forage Crops Technical Committee, subproject 1 was activated and funds available (\$18,000 total) were assigned to North Carolina, Georgia and Kentucky. A work conference was held at Knoxville, Tenn., in February 1954, to activate other projects as it appeared at that time that additional funds would be available. A work planning conference of forage crops breeders was held in Atlanta, Ga., in April to discuss breeding projects and breeding methods and techniques. Projects have been submitted and approved from most of the southern states covering one or more subprojects, so that all subprojects are now activated. The State representatives on the S-12 Technical Committee are as follows:

R. E. Blaser, Virginia	C. R. Owen, Louisiana
O. E. Sell, Georgia	J. R. Harlan, Oklahoma
H. W. Bennett, Mississippi	E. Boneta-Garcia, Puerto Rico
E. C. Holt, Texas	W. R. Paden, S. Carolina
J. K. Leasure, Tennessee	E. D. Donnelly, Alabama
W. W. Woodhouse, N. Carolina	P. C. Sandal, Arkansas
G. B. Killinger, Florida	E. N. Fergus, Kentucky

Full information from each state can be secured from your representative on the Technical Forage Crops Committee.

Report on S-12 Subproject I

X Statistical Evaluation of Pasture Data - Roger Peterson, N. Car.
Agr. Exp. Station, Raleigh, N. Car.

According to Dr. Peterson, the following four lines of work are supporting projects to Subproject 1 of S-12:

Objective a-i: To ascertain the nature and magnitude of experimental errors associated with grazing trials; and to develop a functional relationship for predicting errors from a knowledge of such variables as, (1) kind of animal, (2) grazing management, (3) unit of measure, (4) pasture size,

(5) type of pasture, (6) number of animals per pasture, and (7) length of grazing period. For this objective we have sought data from replicated grazing trials conducted by pasture workers in the southern region, and data have been received from Stations in Arkansas, Georgia, Indiana, Kentucky, Texas and Virginia. These data include 17 trials with beef cattle, 7 experiments with dairy cattle, 3 trials with sheep and one with swine. Additional data have been promised from Florida, Georgia, Oklahoma, Texas, Utah and Virginia.

The data on hand represent either small pastures (0.3 - 6 acres) or very large pastures (107 - 250 acres). However, to completely characterize errors as a function of pasture size we are in need of data from replicated trials with pastures of intermediate size (10 - 30 acres), and we would appreciate knowing if such data are available.

When the data are received, the following information is computed: #TDN produced per acre by each pasture, number of days/acre each pasture was grazed (by 2 methods), average daily gain (of testers and of all animals) and gain per acre (by 3 methods). A statistical analysis is then run on each of these measures to determine the experimental errors associated with each measure in that experiment. Where more than one year's data are available, estimates of the year x treatment and year x pasture components of error are obtained. A report of the statistical analysis of the data is then sent to the experimenter.

The estimates of error for single seasons obtained from all experiments are now being used to verify and extend the formulas obtained from general information and consideration of the size of errors in agronomic trials and barn feeding trials, given by Mott and Lucas in the Proceedings of the 6th. International Grassland Congress. In addition, similar relationships are being developed for short grazing periods (2, 4, and 6 wks.), as well as for the year x pasture and year x treatment components of error.

In connection with the computation of pasture yields by the TDN method (Mott and Lucas opcit) factors for estimating the TDN required for maintenance and gain of sheep and swine on pasture are being sought. Usable estimates of these factors have been obtained for sheep. Factors for swine and further refinement of the sheep factors will be developed as appropriate data become available.

Objective a-ii: To determine the magnitude of the correlations which exist between small plot measurements of yield, botanical and chemical composition, and the per acre and per animal yields of grazed pastures. To develop functional relationships between small plot and grazing trial data. For this objective, data are being sought which will permit the correlation of small plot data with data from similar pasture trials. Data have been received from Kentucky and Texas. Additional data have been promised from Alabama, Georgia, North Carolina and Virginia.

As the data are received, simple and multiple correlations will be run between the small plot results and the various measures of pasture yields. If these correlations are sufficiently high an attempt will be made to develop equations for predicting pasture and animal performance from small plot results.

Objective a-iii: To assess the errors associated with cage and mower-strip methods under a variety of conditions; to ascertain possible means of reducing these errors, and to compare cage and mower-strip results with those obtained by "indicator", point quadrant and other methods.

No work has been done on this objective as a part of the project. Data are on hand, however, from one cattle and one sheep experiment in North Carolina. Additional data are available in Alabama, Georgia, Oklahoma, Kentucky, North Carolina and South Carolina. However, we would appreciate knowing if other such data are available. It is anticipated that work will get under way on this objective within the coming year. Location of the sources of such data will be appreciated.

Objective a-iv: To determine the nature and magnitude of errors associated with "indicator techniques" and to minimize the errors associated with the feeding of "external indicators". Data applicable to this objective have been obtained from Alabama, Georgia and North Carolina.

In studies with tame pastures in North Carolina, Reid's Chromogen method has given good results in digestion trials with barn-fed animals. Poor results (50% recovery) were obtained with a native forage, switch cane (arundinacea), due, possibly, to interfering pigments or to extremely low chloroplast content of this species.

Since it has been shown that Reid's Chromogen is essentially chlorophyll and its degradation products, a procedure for determining chlorophyll derivatives developed by the Cerophyll Laboratories was tried. This procedure gave good results but is very time consuming. Good recovery was obtained by a much shortened procedure. Feed and fecal samples were treated with 0.095 N Cu Cl₂ in 1.13 N HCl for 2-4 hours prior to extraction. Extraction was then made according to Reid's method. The extracts were allowed to stand over night and then read.

* Methods of Forage Evaluation by Animals - (M. E. McCullough,
Ga. Agr. Exp. Station, Experiment, Ga.)

Mr. McCullough pointed out the fact that forage is only one component of animal feed; that pressure on the animal nutritionist to utilize forage has not been too great. As long as the livestock industry is in relatively good condition he does not anticipate any change in this respect. The techniques developed to date are not final methods but are very preliminary. At the Work Planning Conference, two states, Kentucky and Georgia, were assigned the problem of evaluating various shortcut techniques of forages. Two approaches are being studied, with Kentucky placing major emphasis on the relative accuracy of the various techniques, while Georgia would study their relative usefulness. At present Virginia, Alabama and North Carolina are cooperating in the program.

Since the project was activated less than a year ago, there has been little accomplished to date. The first year's results from Virginia and Kentucky indicate that chromic oxide does not act the same with different forages. Chromogen appears to be more stable but certain problems remain to be worked out in its use.

As to "usefulness" of certain components of forages, dry matter digestibility figures appear quite valuable unless you are primarily interested in forage intake. Every forage seems to have its own range of digestivity. Percent digestibility between the species are not comparable, that is, orchardgrass at 70% digestibility is not the same as Starr millet having the same percent digestibility. Within the same species, percent digestibility is important.

✓ Business Meeting - J. K. Leasure, Chairman

Meeting place for 1955: Dr. Leasure presented a letter from Dean J. H. McLeod, Dean and ^Director of the Tenn. Agric. Expt. Station, inviting the organization to Tennessee in 1955. The letter is as follows:

Dear Mr. Leasure:

On behalf of the University of Tennessee College of Agriculture, we extend to you and your organization a very cordial invitation to hold your 1955 annual conference on the campus of the University of Tennessee in Knoxville. We are well equipped to serve a group of this kind, in that we have available on the Agricultural Campus an auditorium with a seating capacity of 200, and if more space is needed, we could obtain the use of a larger auditorium on the main campus of the University. The seats of our auditorium are arranged in elevated tiers and we have facilities for showing motion pictures and slides as well as adequate smaller rooms for committee or sectional conferences.

We feel that the University of Tennessee enjoys exceptional advantages in the matter of favorable location for conferences of this kind because of its proximity to TVA reservoirs which provide fishing, boating and swimming; the Great Smoky Mountain National Park (which must be seen to be appreciated) and the American Museum of Atomic Energy at Oak Ridge, which has the distinction of being the only one of its kind in the world.

Since the spring of the year in East Tennessee is such a delightful season, I should like to suggest that those attending the conference bring their families, and come either several days before or stay several days after the conference, for a vacation. There are adequate housing facilities available at hotels, motels and tourist courts, both in Knoxville and at Gatlinburg, which is the entrance to the Smoky Mountain National Park.

We hope we may be honored by having the Sou. Pasture and Forage Crop Improvement Conference held on our campus in 1955, and assure you we shall do everything possible to make this occasion convenient and pleasant in every way.

Very truly yours,

/s/ J. H. McLeod
Dean and Director

It was moved and seconded that the Conference accept the invitation from Tennessee for their 1955 meeting. The motion passed unanimously. A letter from Dr. L. V. Crowder was read, expressing the hope that the Conference would meet at Experiment, Georgia, in 1957. Originally, Dr. Crowder had hoped that the organization could meet with them in 1956, however, because of drouths and the necessity of moving to a new experimental area, he felt that 1957 would be a more desirable year for Georgia. Dr. H. W. Bennett, from Mississippi, expressed the desire to have the group meet in Mississippi in 1956. No action was taken on the above two proposals.

Nominations for a member of the Executive Committee for the period 1955-59: A nomination committee composed of R. E. Wagner (Chairman), R. C. Potts and G. W. Burton, nominated Dr. L. V. Crowder (Ga.) and Dr. W. E. Knight (Miss.). The motion was made and seconded that the nominations cease. In the vote, by raise of hands, Dr. Crowder was elected as the new member of the Executive Committee to serve during the period 1955-59.

Dr. Leasure called attention to the order of chairmanship within the Executive Committee and introduced Dr. Paul C. Sandal (Ark.) as Chairman for 1955. The Committee now stands as follows:

R. C. Potts, Texas	1955	L. V. Crowder, Ga.	1959
J. K. Leasure, Tenn.	1956	R. H. Lush, Tenn., Dairy Husb.	
P. C. Sandal, Ark.	1957 Chairman	H. H. Leveck, Miss., Animal Husb.	
D. S. Chamblee, N. Car.	1958.	P. R. Henson, Permanent Sec'y.	

Dr. Potts moved that Dr. Leasure be given a standing vote of thanks for the excellent handling of the Conference the past year. The motion was seconded and unanimously executed.

Dr. Leasure moved that the secretary send a letter to Dr. Harlan expressing our appreciation to him and his associates for the excellent facilities and planning which resulted in a very successful conference. The motion was seconded and unanimously passed.

The program committee for next year was announced as P. C. Sandal (Ark.), H. W. Bennett (Miss.), D. E. McCloud (Fla.) and the Secretary.

There being no further business, the conference adjourned at 10:45 AM, June 10, 1954.

Southern Pasture and Forage Crops Improvement
Conference

Registration List - 1954

Ayers, Thos. L.	Washington, D. C.	A. C. P. Service, USDA
Anderson, K. L.	Manhattan, Kansas	Kans. Agric. Expt. Station
Arora, R. M.	Stillwater, Okla.	Okla. " " "
Atkins, Don	Manhattan, Kans.	Kans. Soil Cons. Service
Bakir, Omer	Stillwater, Okla.	Okla. Agric. Expt. Station
Baldrige, J. D.	Columbia, Mo.	Mo. " " "
Bashaw, E. C.	College Station, Tex.	Tex. " " "
Beard, D. F.	Beltsville, Md.	Forage & Range Sect., USDA
Bennett, H. W.	St. College, Miss.	Miss. Agric. Expt. Station
Blaser, R. E.	Blacksburg, Va.	Va. " " "
Brown, E. Marion	Columbia, Mo.	Mo. " " "
Celarier, R. P.	Stillwater, Okla.	Okla. " " "
Burton, G. W.	Tifton, Ga.	Coastal Plain Expt. Station
Chamblee, D. S.	Raleigh, N. Car.	N. C. Agric. " "
Chessmore, R. A.	Ardmore, Okla.	Samuel Roberts Noble Foundation
Chiles, R. E.	Stillwater, Okla.	Okla. Agric. Expt. Sta.
Coit, R. P.	Crescent, Okla.	
Cook, E. D.	Temple, Tex.	Tex. Substation No. 5
Cooper, H. W.	Lincoln, Nebr.	USDA, Soil Conservation Serv.
Cowan, J. R.	Corvallis, Oreg.	Oreg. Agric. Expt. Station
Cremer, C. L.	Woodward, Okla.	Okla. " " "
Dobson, S. H.	Raleigh, N. Car.	N. C. " " "
Doll, E. H.	Lincoln, Nebr.	Soil Conservation Service
Donnelly, E. D.	Auburn, Ala.	Ala. Agric. Expt. Station
Denman, C. E.	Stillwater, Okla.	Okla. A & M College
DeVane, E. H.	Tifton, Ga.	Coastal Plain Expt. Station
Elder, W. C.	Stillwater, Okla.	Okla. Agric. " "
Fergus, E. N.	Lexington, Ky.	Ky. " " "
Forbes, Ian, Jr.	Tifton, Ga.	Coastal Plain Expt. Station
Gardner, F. P.	Athens, Ga.	Ga. Agric. " "
Gibson, P. B.	Auburn, Ala.	Ala. " " "
Graumann, H. O.	Beltsville, Md.	Forage & Range Sect., USDA
Gurgan, Yildirim	Stillwater, Okla.	Okla. Agric. Expt. Station
Halls, L. K.	Tifton, Ga.	Coastal Plain Expt. Station
Hanson, A. A.	Beltsville, Md.	Forage & Range Sect., USDA
Harlan, J. R.	Stillwater, Okla.	Okla. Agric. Expt. Station
Hawk, V. B.	Ames, Iowa	Soil Conservation Service
Henson, P. R.	Beltsville, Md.	Forage & Range Sect., USDA
Hogg, P. G.	Stoneville, Miss.	Delta Expt. Station
Holt, E. C.	College Station, Tex.	Tex. Agric. Expt. Station
Hood, E. L.	Goodwell, Okla.	
Hoover, Max M.	Ames, Iowa	Iowa " " "
Huffine, W. W.	Stillwater, Okla.	Okla. " " "
Hunt, Harold	Laramie, Wyo.	Wyo. " " "
Jackson, S. K.	Raleigh, N. Car.	N.C. " " "
James, Edwin	Griffin, Ga.	Ga. " " "
Jones, D. W.	Ona, Fla.	Range Cattle Station
Jones, M. D.	Stillwater, Okla.	Okla. Agric. Expt. Station

Kalton, R. R.	Ames, Iowa	Iowa Agric. Expt. Station
Keller, Wesley	Logan, Utah	Utah " " "
Killinger, G. B.	Gainesville, Fla.	Fla. " " "
Kneebone, W. R.	Woodward, Okla.	Sou. Great Plains Field Station
Knight, W. E.	State College, Miss.	Miss. Agric. Expt. Station
Kreitlow, K. W.	Beltsville, Md.	Forage & Range Sect., USDA
Langford, W. R.	Auburn, Ala.	Ala. Agric. Expt. Station
Law, A. G.	Pullman, Wash.	Wash. " " "
Leasure, J. K.	Knoxville, Tenn.	Tenn. " " "
Lynd, J. Q.	Stillwater, Okla.	Okla. " " "
Mondart, C. L. Jr.	Baton Rouge, La.	La. " " "
McCloud, D. E.	Gainesville, Fla.	Fla. " " "
McCullough, M. E.	Experiment, Ga.	Ga. " " "
McGuire, W. S.	State College, Miss.	Miss. " " "
MacVicar, Robt.	Stillwater, Okla.	Okla. " " "
Marchant, W. H.	Tifton, Ga.	Coastal Plain Expt. Station
Matlock, R. S.	Stillwater, Okla.	Okla. Agric. " "
Neel, L. R.	Nashville, Tenn.	Farm & Ranch Magazine
Nelson, A. B.	Stillwater, Okla.	Okla. Agric. Expt. Station
Newell, L. C.	Lincoln, Nebr.	Nebr. " " "
Nichols, Robt.	Dallas, Tex.	Farm & Ranch Magazine
Paden, W. R.	Clemson, S. Car.	S. C. Agric. Expt. Station
Parker, E. M.	Atlanta, Ga.	
Pass, Bill	Stillwater, Okla.	Okla. Agric. Expt. Station
Patterson, J. K.	Pullman, Wash.	Wash. " " "
Parkey, Wade	Stillwater, Okla.	Okla. " " "
Peacock, F. M.	One, Fla.	Range Cattle Station
Peterson, R. G.	Raleigh, N. Car.	N. C. Agric. Expt. Station
Pickett, R. C.	Manhattan, Kans.	Kans. " " "
Pope, L. S.	Stillwater, Okla.	Okla. " " "
Potts, R. C.	College Station, Tex.	Tex. " " "
Reid, E. H.	Ft. Collins, Colo.	Forest Service
Richardson, Bill	Stillwater, Okla.	Okla. Agric. Expt. Station
Rogler, G. A.	Mandan, N. Dak.	N.D. " " "
Ross, Jim	Brookings, S. Dak.	S.D. " " "
Sandal, P. C.	Fayetteville, Ark.	Ark. " " "
Sell, O. E.	Experiment, Ga.	Ga. " " "
Siegeuthaler, I. E.	Altomont, Kans.	
Smith, H. C. Jr.	Knoxville, Tenn.	Tenn. " " "
Smith, T. J.	Blacksburg, Va.	Va. " " "
Staten, Glenn	State College, N. Mex.	N. Mex. " " "
Staten, Raymond	Fayetteville, Ark.	Ark. " " "
Stephens, J. L.	Tifton, Ga.	Coastal Plain " "
Stitt, R. E.	Bozemen, Mont.	Mont. Agric. " "
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